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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PUB. CO.,

VOL. 19. 256 BROADWAY, NEW YORK. No. 44.

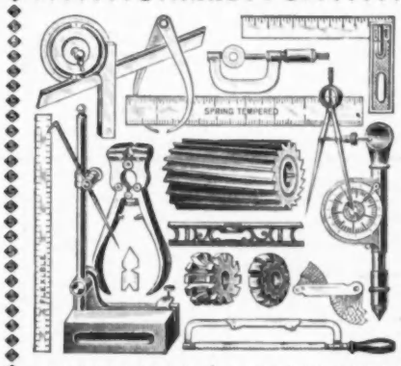
CONTENTS.

PAGE

A Triple-Expansion High-Speed Engine 1013
New Shop of the Bickford Company.1015
A Large Grinding Machine.....1016
Design of Stepped Cones—Klein's Diagram. By G. A. Goodenough..1016
The Records of Experience.....1018
A New Gage.....1019
Some Notes on Windmills. By Prof. De Volson Wood.....1019
American Locomotive Pistons.....1020
Electrical Machinery: Electrical Devices for Changing the Speed of Series Motors. By Wm. Baxter, Jr.....Special Portable Drilling Machine 1022, 1023
Letters from Practical Men: Hardening Steel in a Gas Furnace. By A. A. Steelman.....Time Test of Machine Tools. By Wm. O. Webber .....Reamers. By C. O. Griffin .....For Reformed Piping. By Tecumseh Swift....Engine Foundations. By W. H. Wakeman..1024-1027
Influence of the English Banking System on our Foreign Trade.....1027
Pipe Joints and Fittings.....1027
A Russian Railroad Man.....1028
Safety Collar for Emery Wheels....1028
Compressed Air Cars of the Metropolitan Traction Company.....1028
A Fast Steam Launch.....1028
The New York State Gun Contest..1029
School Draftsmen.....1029
Planer Speeds.....1030
The Bates Thermic Engine.....1030
Questions and Answers.....1030
Fabric for Bicycle Tire—Testing Tubes 1031
Polishing Aluminum.....1032
Commercial Review.....1032

Index to Articles Advertised, Pages 10 to 13.
Index to Advertisers, Page 9.

STARRETT'S



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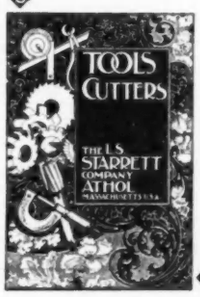

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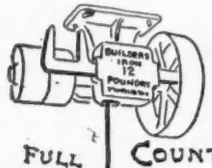

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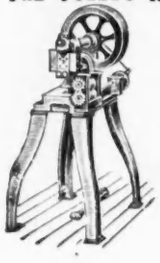

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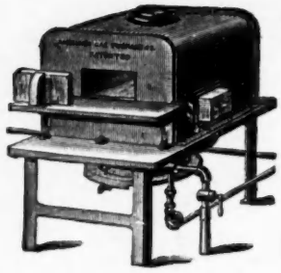

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Index to Advertisers.

	PAGE
Abbott, Wheelock & Co.	5
Acme Machinery Co.	14
Adt & Son, John	6
Albro-Clem Elevator Co.	6
Almond, T. R.	8
Alteneder & Sons, T.	43
American Gas Furnace Co.	2
Ames Iron Works	46
Arcade File Works	14
Armstrong Mfg. Co.	8
Ashcroft Mfg. Co.	48
Audel & Co., Theo.	40
Aurora Tool Works	6
Baird & Co., Henry Carey	41
Baker Bros.	45
Ball-Bearing Co., The	13
Barker & Co., William	5
Barnes Co., W. F. & John	5
Bates, Henry H.	5
Besly & Co., Chas. H	41
Bethlehem Foundry and Machine Co.	40
Bickford Drill and Tool Co.	43
Bickford, H.	48
Bilgram, Hugo	11
Blaisdell & Co., P.	11
Bliss Co., E. W.	5
Boston Gear Works	46
Box 62	13
Bradford Mill Co., The	5
Bradley Co., The	39
Brainard Milling Machine Co.	41
Bremer Machine Co., Godfrey J.	6
Brown & Sharpe Mfg. Co.	48
Buffalo Forge Co.	47
Builders Iron Foundry	2
Bullard Machine Tool Co.	7
Central Packing Works	4
Cincinnati Milling Machine Co.	41
Cleveland Machine Screw Co.	7
Cleveland Twist Drill Co.	43
Clough, R. M.	37
Coburn Trolley Track Mfg. Co., The	6
Coffin & Leighton	41
Columbia University	37
Compressed Air	43
Conover Mfg. Co.	13
Crescent Steel Co.	44
Crocker-Wheeler Electric Co.	4
Cumberland Iron & Steel Shafting Co.	5
Curtis & Curtis	37
Cushman Chuck Co.	3
Daimler Motor Co.	4
Dallett & Co., Thos. H.	4
Davis & Egan Mach. Tool Co	45
Deane Steam Pump Co.	14
Detrick & Harvey Machine Co.	47
Diamond Machine Co.	41
Dietz, Schumacher & Boye	47
Dixon Crucible Co., Joseph	45
Dwight Slate Machine Co.	2
Dyer & Driscoll	39
Egan Co., The	3
Elliott Chemical Works	4
Erlandsen, J.	6
Evans Friction Cone Co	41
Ferracute Machine Co.	8
Field Monument Souvenir Fund	45
Fifield Tool Co.	48
Fitchburg Machine Works	43
Flather & Co.	47
Forbes & Co., W. D.	45
Fox Machine Co.	40
Frick Co., The	46
Garvin Machine Co., The	8 and 13
General Electric Co.	3
Gisholt Machine Co.	45
Goodyear, S. W.	4
Gould & Eberhardt	14
Grant Gear Works	14
Gray Co., G. A.	14
Greenfield, W. G. & G.	46
Guild & Garrison	13
Hamilton Machine Tool Co.	2
Hampden Corundum Wheel Co.	3
Harrington & King Perforating Co.	48
Hartford Steam Boiler and Ins. Co.	40
Hendey Machine Co.	38
Henley & Co., N. W.	37
Hill, Clarke & Co.	9
Hoggson & Pettis Mfg. Co.	3
Home Study	48
Hoppes Mfg. Co., The	13
Horton & Son Co., E.	3
Hurlbut-Rogers Machine Co	47
Hyatt Roller Bearing Co.	2
Ingersoll-Sergeant Drill Co.	46
Jenkins Bros.	39
Johns Mfg. Co., H. W.	47
Jones & Co., B. M.	2
Jones & Lamson Machine Co.	14 and 48
Kempsmith Machine Tool Co.	47
Keuffel & Esser Co	8
Keystone Engine and Machine Works	46
Landis Bros	2
Le Blond, R. K.	11
LeCount, Wm. G	3
Lodge & Shipley Machine Tool Co	7
Long & Allstatter Co.	3
Maris Bros.	47
McCabe, J. J.	8
McFadden Co.	7
Miner & Peck Mfg. Co.	47
Monighan Machine Works	8
Montgomery & Co	3
Morse Twist Drill & Machine Co.	4
Mossberg & Granville Mfg. Co.	41
National Chuck Co	3
National Machinery Co	6
Newark Machine Tool Co.	6
New Haven Mfg. Co.	10
Nicholson File Co	14
Niles Tool Works Co.	14
Niles Tool Works Co., N. Y. Branch	8
Norton Emery Wheel Co.	39
Oneida Mfg. Chuck Co.	3
Ott Mergenthaler & Co	8
Otto Gas Engine Works	46
Pancoast Ventilator Co	3
Patterson, Gottfried & Hunter	6
Penberthy Injector Co.	11
Philadelphia Book Co.	40
Pierce Engine Co	46
Pope Tube Co., The	5
Pratt & Whitney Co.	39
Pratt Chuck Co.	3
Prentiss Tool & Supply Co.	8
Pryibil, P	10
Q. and C. Co	43
Rand Drill Co.	46
Ransom, Perry	4
Reece, Edw. J.	8
Reed Co., F. E	41
Reinecker, J. E.	46
Reynolds Bros.	2
Roots, P. H & F. M.	47
Sackmann, F. A.	8
Saunders' Sons, D.	6
Sawyer Tool Co	6
Sebastian Lathe Co.	39
Sellers & Co., Inc., Wm.	14
Seneca Falls Mfg. Co.	39
Shriver & Co., T.	43
Sibley & Ware	6
Skinner Chuck Co.	3
Slocomb & Co., J. T.	11
Snyder, J. E.	10
"Specialty"	5
Springfield Gas Engine Co., The	46
Standard Tool Co.	14
Stark, John	43
Starrett Co., L. S.	1
Stiles & Fladd Press Co., The	40
Sterling Emery Wheel Mfg. Co.	43
Strelinger & Co., Chas. A.	4
Sturtevant Co., B. F.	47
Stuart's Foundry & Machine Works, R. J.	48
Taunton Locomotive Mfg. Co.	43
Timolat, J. G.	2
Toledo Machine & Tool Co.	2
Toomey Frank	8
Torrington Mfg. Co.	4
Trump Bros. Machine Co.	10
Vitrified Wheel Co.	10
Warner & Swasey	48
Waterbury-Farrel F'dry & Mach. Co.	47
Waterbury Machine Co., The	3
Watson-Stillman Co., The	12
Webster Mfg. Co	37
Webster & Perks Tool Co.	41
Wedderburn & Co., John	48
Wells Bros. & Co.	2
Welis, Heber	43
Weston Engine Co.	46
Wetherill Machine Co., James P.	5
Whitcomb Mfg. Co.	7
Whiton Machine Co., D. E.	3
Wiley & Sons, John	39
Wiley & Russell Mfg. Co.	39
Wilkinson & Co., A. J.	2
Wilson, W. A.	4
Woodward & Rogers	45
Worcester Machine Screw Co.	47
Wyke & Co., J.	40
Wyman & Gordon	48

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One 16" x 6' Taper Engine Lathe, Flather.
One 16" x 16' Taper Engine Lathe, Blaisdell.
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One 18" x 8' Engine Lathe, Florence.
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One 20" x 14' Engine Lathe, Blaisdell.
One 21" x 10' Engine Lathe, Flather.
One 21" x 12' Engine Lathe, New Haven.
One 22" x 10' Engine Lathe, Pond.
One 24" x 10' Engine Lathe, New Haven.
One 24" x 15' Engine Lathe, New Haven.
One 24" x 15' Engine Lathe, Blaisdell.
One 24" x 12' Engine Lathe, Flather.
One 32" x 14' Engine Lathe, New Haven.
One 32" x 19½' Engine Lathe, New Haven.
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One 30" x 30" x 8' Planer, Powell.
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Davis & Egan Mach. Tool Co., Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Ferracute Machine Co., Bridgeton, N. J.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
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Wiley & Russell Mfg. Co., Greenfield, Mass.

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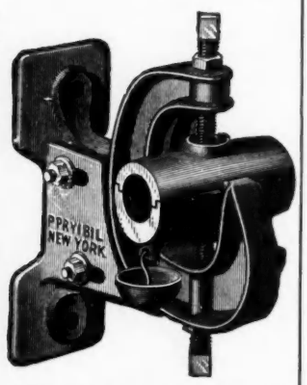

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Slocomb & Co., J. T., Providence, R. I.

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Cushman Chuck Co., Hartford, Conn.
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Horton & Son Co., E., Windsor Locks, Conn.
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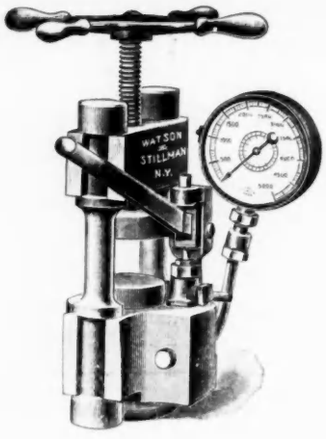

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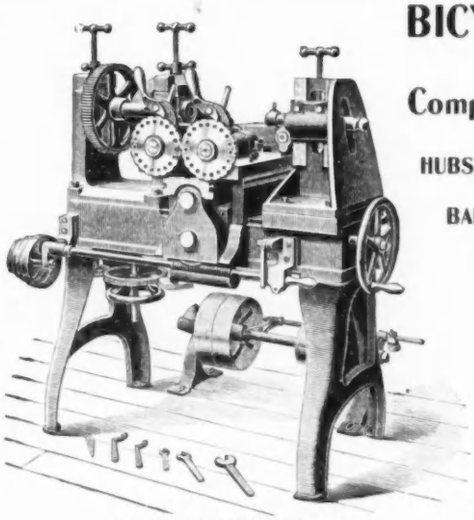

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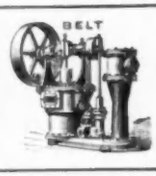

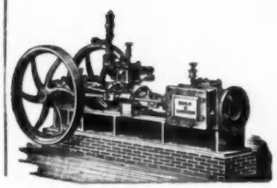

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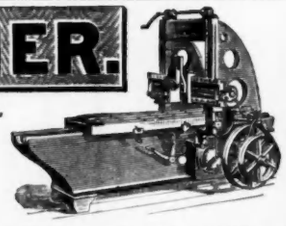

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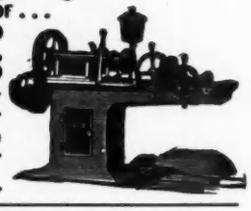

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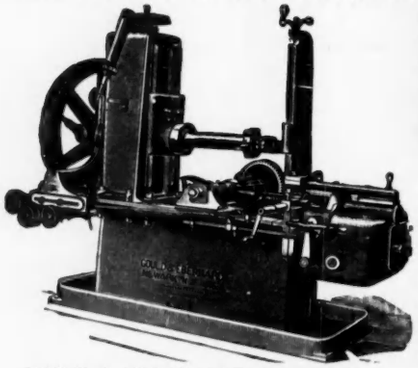

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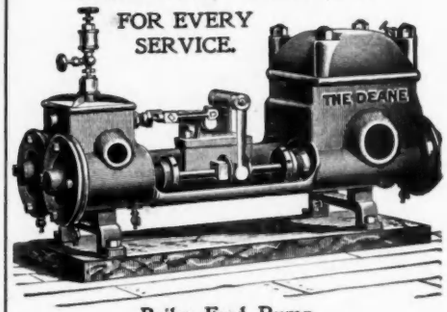

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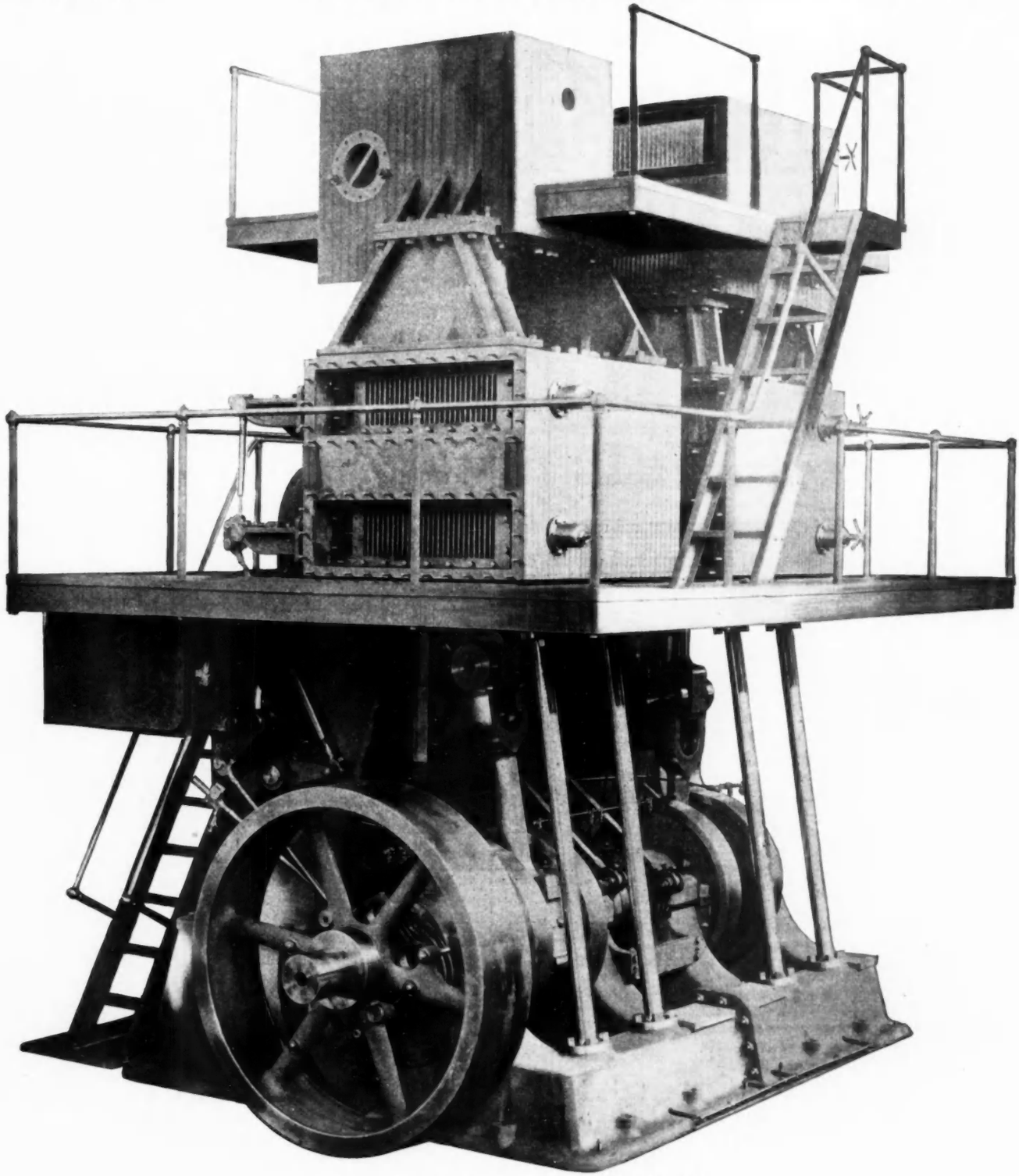


Fig. 1. HIGH-SPEED TRIPLE-EXPANSION ENGINE.

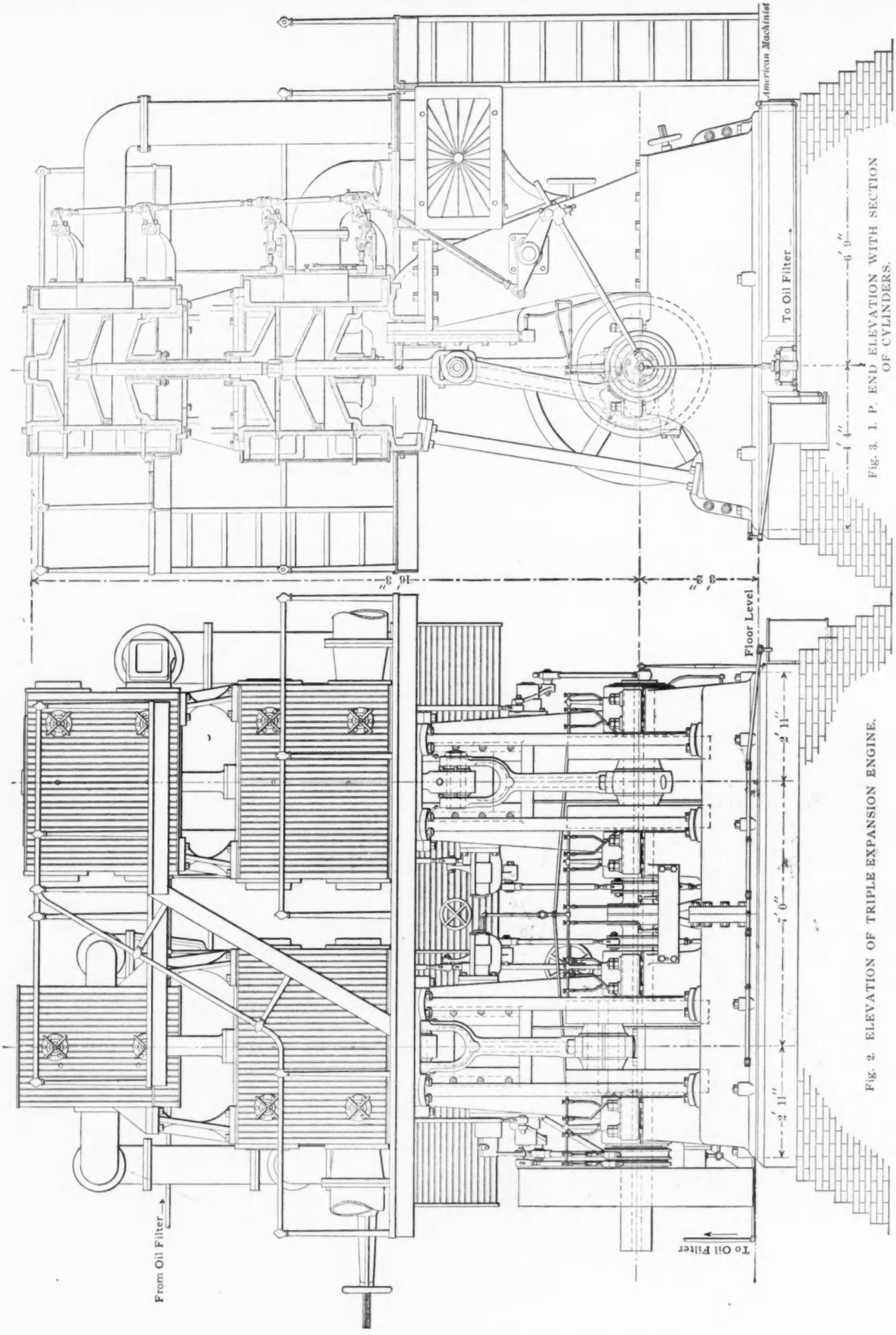


Fig. 3. I. P. END ELEVATION WITH SECTION OF CYLINDERS.

Fig. 2. ELEVATION OF TRIPLE EXPANSION ENGINE.

A Triple-Expansion High-Speed Engine.

We illustrate this week a vertical high-speed triple-expansion four-cylinder engine possessing a number of interesting features. The engine was built by McIntosh & Seymour, Auburn, N. Y., for the Jefferson Mill, Manchester, N. H., one of the fine mills of the Amoskeag Corporation. It is nominally of 2,150 horse-power, and is required to run under some peculiar and exacting conditions. The engine shaft is coupled directly to a water-wheel shaft which runs at 232 revolutions per minute, and the high speed rendered it necessary to reduce the weight of the reciprocating parts to the lowest possible.

The cylinder diameters are, successively, 22½ inches, 36 inches, and two of 40 inches each, with a common stroke of 22 inches, the piston speed being just over 850 feet per minute. The ratio of the intermediate cylinder to the high-pressure is 2.56, of the two low-pressure cylinders to the intermediate 2.47, and of the two low-pressure to the high-pressure 6.32. The engine has two cranks at right angles, one low-pressure cylinder over each crank, with the high-pressure cylinder tandem above one, and the intermediate above the other. The half-tone, Fig. 1, is from the high-pressure end, showing the automatic shaft governor which controls the high-pressure cut-off only, and has a range from 0 to 0.9 stroke. The main valve of the high-pressure cylinder is a double piston valve operated by a fixed eccentric and controlling both admission and exhaust. This valve is provided with adjustable seats. The cut-off valve, operated by the governor, is a simple sleeve riding on the main valve.

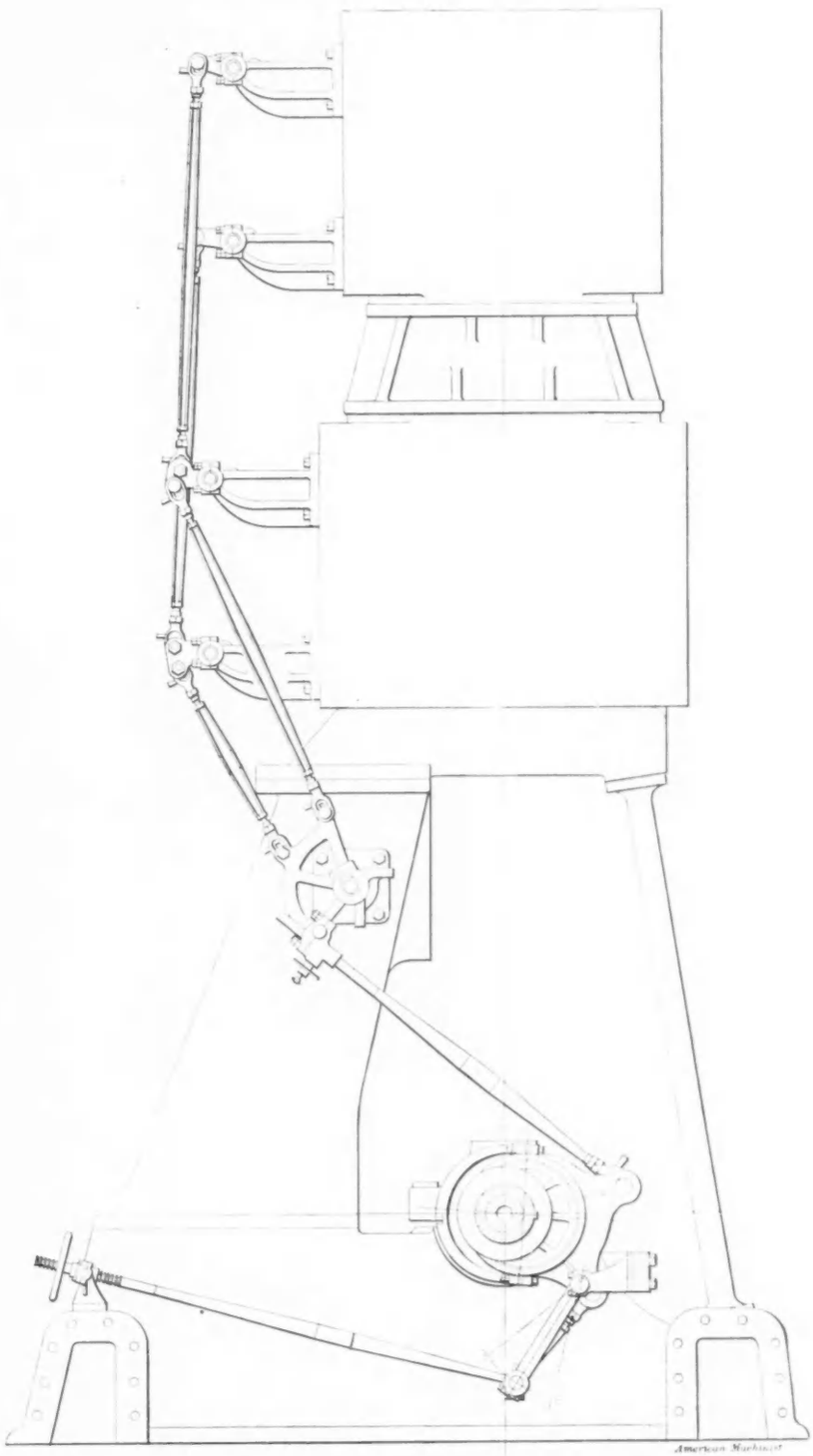


Fig. 4. I. P. AND H. P. ADJUSTABLE CUT-OFF GEAR.

The other cylinders are provided with gridiron valves, shown very clearly in section by Fig. 5. These valves afford a phenomenally free passage for the steam, and at the same time the clearances are quite small. The valves are positively driven, Fig. 4 showing the arrangement of connections and also the means by which the cut-off is changed at the will of the engineer. The valves have a movement of only ¾ inch, and as this movement occurs when the valves are balanced, but little power is required to operate them, and no sudden and severe strains occur. The seats for all the valves are removable and renewable, and all the ports are milled.

Figs. 7, 8 and 9, showing the connecting rod, crosshead and crank shaft, respectively, are interesting studies in modern construction. They will require little explanation for our readers. The engravings have necessarily been made of sizes adapted to our columns, and the cuts are not all to the same scale, but the scale of each may be inferred from some dimension which we give. The aim at lightness in all the parts is sufficiently evident throughout, and its successful accomplishment not less so. The connecting rods, it will be noticed, have a hole through the center for the entire length, and the internal milling-out of the yoke end of the rod is also interesting. The length from center to center is 60 inches. The pin which works in the crosshead is also hollow. This pin has taper fits in the two sides of the rod, and is secured by a nut on the end; the working part of the pin is 6 inches diameter and 10 inches long. The crank-pin boxes are cast steel lined with babbitt; they are 10 inches diameter and 14 inches long. The caps are bolted up tight and the nuts secured by a set screw against the round part of the nut, which is sunk into a counterbore in the rod. A number of shims of different thicknesses are inserted in the joint, and the box may be taken up by removing a shim. The little clips at the side prevent the shims from slipping out if they become loose.

The successful lightening of parts is

perhaps shown better in the crosshead than anywhere else. The piston rod has an end similar to what we expect to find on a connecting rod, with a wedge take-up for the boxes to keep them adjusted to the pin in the forked end of the connecting rod, and a light phosphor bronze shoe bolted to the side of this piston-rod head, as shown in the drawing, constitutes the entire crosshead. The adjustment for the wear of the crosshead is provided for on the slides.

The crank shaft is in two pieces, connected, as shown, by flange couplings and bolts. It will be noticed that there is a steel plate between the coupling flanges. When the coupling bolts and this plate are removed, the high-pressure end of the engine may be run alone as a single compound engine, developing in this way 75 per cent. of the full power of the engine, although not with as high economy. The crank shaft is made from two ingots of fluid-compressed hydraulic-forged nickel steel, made by the Bethlehem Iron Company, the cranks being cut out of the solid, and a great weight of metal being removed in bringing the shafts to shape and dimensions. The finished weight of the shaft was 55,362 pounds. The shaft body and the pins are all 10 inches diameter, with 3-inch axial holes entirely through each. The balancing disks are secured to the crank webs by tap bolts and heavy keys, as shown; the thin half ring carried around to complete the circle

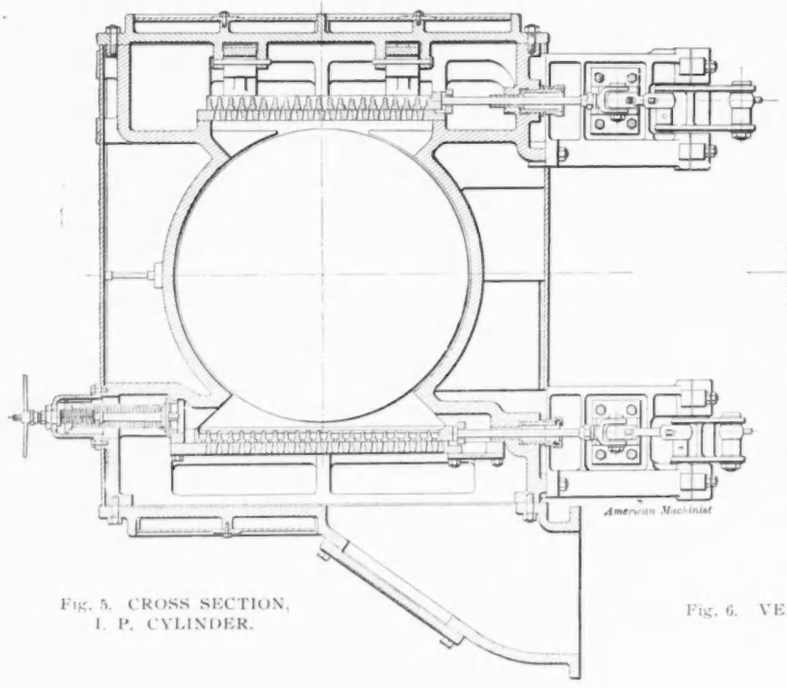


Fig. 5. CROSS SECTION, I. P. CYLINDER.

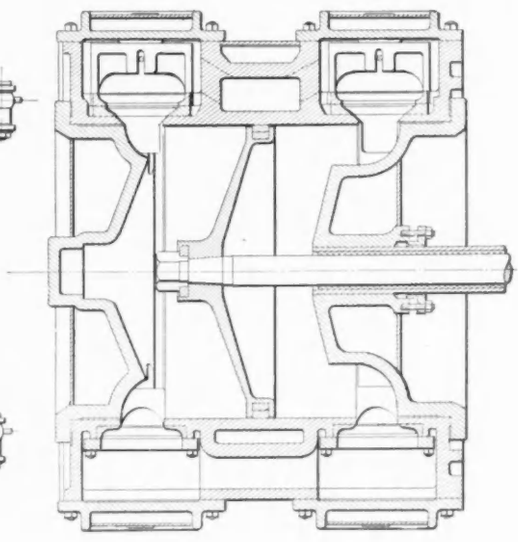


Fig. 6. VERTICAL SECTION OF I. P. CYLINDER.

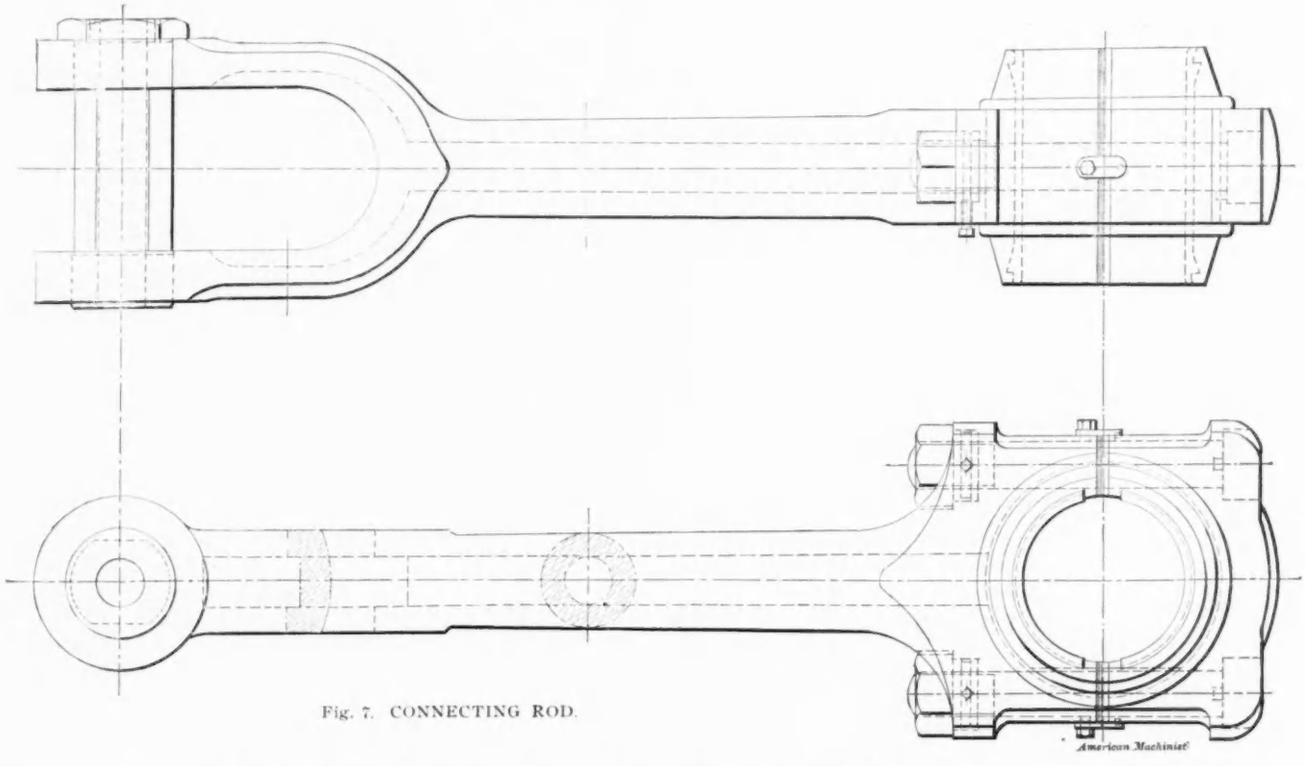
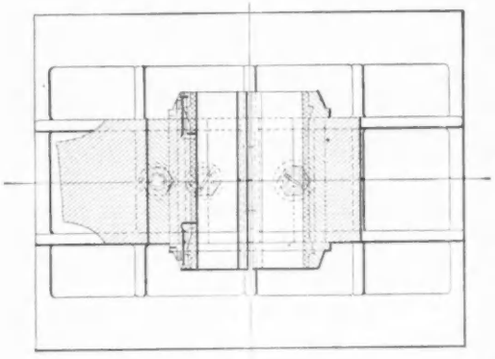


Fig. 7. CONNECTING ROD.

of the disk has no other use than that, and the counterbalance with that half ring removed might have been also lightened to the same extent around the other half. These counterbalances balance, in addition to the cranks and pins, .8 of the weight of the connecting rods. About two-thirds of the weight of the connecting rod should be balanced in order to make the engine in running balance horizontally, so that there is only a slight excess of counterbalance for this condition, and the material unbalanced forces are all vertical, where they can be well taken care of by the foundation. One-third of the total weight of the reciprocating parts, including pistons, piston rings, crosshead and connecting rod complete, is balanced by the counterbalance on the high-pressure side. On the intermediate side of the engine, where the intermediate piston is a little heavier, .3 of the total weight of the reciprocating parts is so balanced. It will be noticed that wearing rings are provided on each side of each crank. These are made in halves and attached by small countersunk screws.



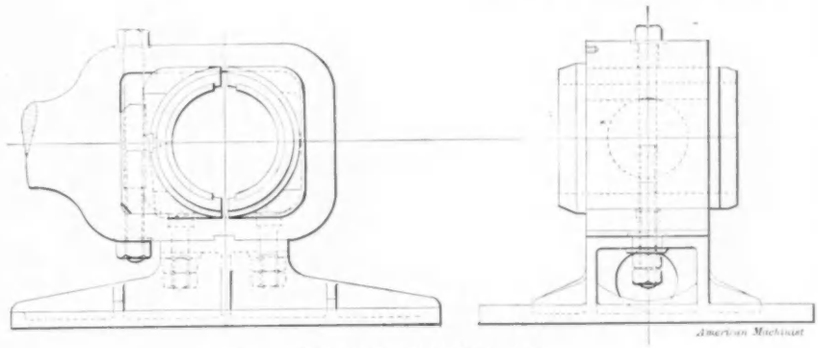


Fig. 8. DETAILS OF CROSSHEAD.

The main bearings of the engine are removable cylindrical shells, babbitt-lined, and surrounded by a space in which water may be circulated if at any time necessary. The pistons are of cast steel and of the conical marine type, and the rods have a taper fit with a nut and locking device. No stuffing boxes are used for the piston rods, long packing sleeves inclosing the entire rod from the inside of the head of the lower cylinder to that of the upper. The stuffing box shown in the upper cylinder head may be regarded rather as an expansion joint for the sleeve.

The frame of the engine is composed of heavy rectangular columns with 2-inch internal ribs where necessary, and, as will be seen, the accessibility of all the parts of the engine is provided for. The high-pressure cylinder is steam-jacketed on the barrel and both heads. Between the several cylinders are receivers with copper heating coils filled with steam at full boiler pressure. In the center of the low-pressure receiver is a sliding diaphragm acting as a gate valve, which is employed with a special arrangement of pipes and valves when the single compound engine is run, as mentioned above.

The initial steam pressure employed may go up to 185 pounds. An injector condenser is used. A home-made feed-water heater is placed in the exhaust connection of the low-pressure cylinder, and by this means an increase of 40 degrees in the temperature of the feed water is said to be obtained.

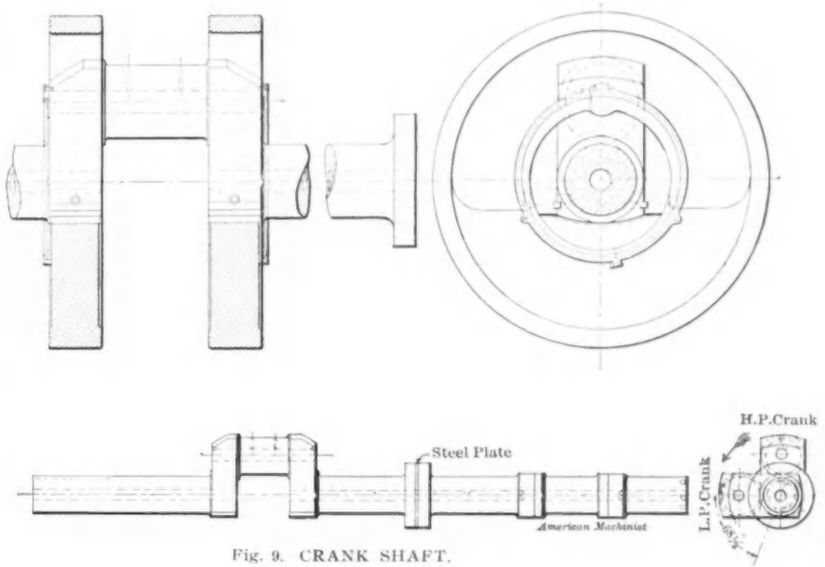


Fig. 9. CRANK SHAFT.

Provision is made for continuous lubrication of the working parts of the engine. An oil pump is a part of the engine, and it takes the returning oil after it has passed through a filter and sends it up again for redistribution.

The engine has now been running more than six months. It runs smoothly, without heating and with close regulation. When developing 1,725 indicated horse-power, it is said to have run on 1.38 pounds of coal per horse-power hour, with jacket and reheater water going to waste.

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New Shop of the Bickford Company.

The new shop building of the Bickford Drill & Tool Company, Cincinnati, is now completed, and they are moving into it. The building contains 25,000 square feet of floor space, and is erected on the old site at the corner of Front and Pike streets. In the construction they have used the most modern methods, so as to give the greatest amount of light possible. On the first floor are the heavy tools, such as planers, lathes, boring mills and radial drills, and also the erecting floor, which part is fitted with three traveling cranes. The second floor has the office, tool-room, lighter lathes, gear cutters, milling machines, together with the lockers for the men. The third floor has the drawing-room, stock-room and vise-benches for manufacturing the smaller parts of the machines in quantities. The shop is modern and model in every way.

▲ ▲ ▲

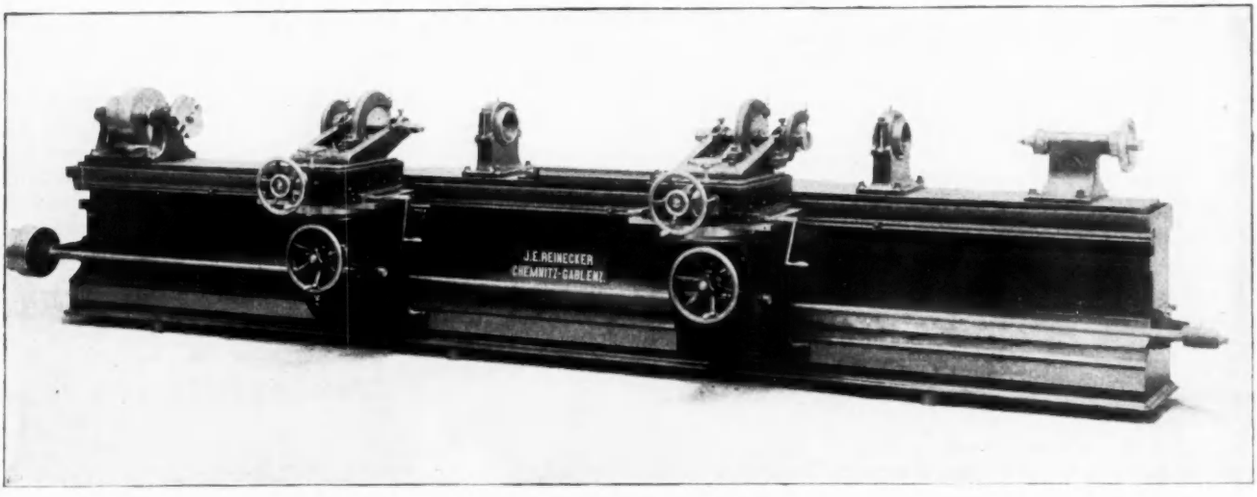
Commencing with January 1, 1897, the city of Glasgow, Scotland, will cease to levy taxes of any kind, or under any disguise, upon its residents. The entire expenses of the city can be borne in future by the income from its public works. The city operates water-works, gas and electric light plants, street railroads, sewage farms and other institutions, all paying large profits.

A Large Grinding Machine.

We present herewith an engraving of a grinding machine which has some interesting features aside from its size, though in this respect it is somewhat remarkable, since it is designed especially for grinding piston rods and to handle work up to 5 meters, or somthing over 16 feet, in length.

Like our own larger grinding machines, the work is not moved endwise for the feed, but the wheel-carrying carriages are fed along the bed, as is, of course, necessary where, as in this case, two carriages are employed which are intended to be used independently of each other, either or both being available for either cylindrical or taper work.

The carriages are attached to the side of the bed, as shown, and are fed by a feed rod and rack and pinion.



A LARGE UNIVERSAL GRINDER.

Below the carriage slides is a graduated swivel plate by which these slides may be set at any desired angle, beside which there is at the left of the right-hand carriage what appears to be something in the nature of a former bar, or guide, by which tapers or special forms may be produced. We are not quite certain about this feature, however, as we have really little information regarding the machine not conveyed by the photograph.

Small tappets will be noticed bolted to a T-slot in the side of the bed, and these, we suppose, automatically reverse the motion of the carriages at any desired point.

The wheels are driven by belts from an overhead drum, which drum is 500 millimeters (19.68 inches) diameter, 6,100 millimeters (20 feet) long, and runs 220 revolutions per minute.

Provision is made for using soda water on the wheels and for taking care of it without running over the machine. Though called a "universal" machine the head does not swivel as our universal machines do.

The machine is made by J. E. Reinecker, Chemnitz-Gablenz, Germany.

Design of Stepped Cones—Klein's Diagram.

The design of stepped cones for open belts is a regular exercise given our sophomores in the "Elements of Machine Design." Considerable attention has been given to the various approximate and exact solutions of the problem, with the idea of ascertaining their advantages and defects.

The solutions may be divided into four classes:

1. The exact analytic method.

2. Approximate analytic methods, such as those of Rankine and Unwin.

3. Approximate graphical solutions. [For a description of some of these, see Trans. Am. Soc. Mech. Eng., X, 269; also Kent's Pocket Book, page 875.]

4. Exact graphical solutions. One of these is the Culmann diagram demonstrated in Reuleaux' Constructor; another is a modification of the Culmann diagram by Prof. J. F. Klein.

Without discussing the merits of these solutions in detail, the conclusions arrived at are as follows:

1. The exact analytic method is extremely difficult to use, and is unsuited to anyone but a mathematical Hercules.

2. The approximate analytic solutions are easy to use, but not sufficiently exact.

3. The approximate graphical methods are convenient and quite accurate.

4. The Culmann diagram as modified by Prof. Klein is exact under all conditions, and when intelligently used is the quickest and most satisfactory solution yet devised. We have, therefore, abandoned all other methods and now pin our faith to the Klein diagram alone.

A description of this diagram and directions for its use may be found in the Journal of the Franklin Institute, 1880; also in Klein's "Elements of Machine Design." There are, however, some practical points which need to be observed in order to obtain the best results. It is the object of this article to call attention to these little details, and further to show a method of using the diagram when the cones are to be designed to give certain velocity ratios:

As shown in the engraving, the diagram consists of two curves—one, $A\,B$, lying above the horizontal axis $A\,D$; the other, $A\,C$, lying below it. The manner of using the diagram is briefly as follows: Draw a line $m\,n$ parallel to $A\,D$ and below it; draw a vertical line $a\,c$ intersecting curves $A\,B$ at a, $A\,C$ at b and line $m\,n$ at c. The length $B\,C$ to some scale may be taken to represent the distance between the shafts or axes of the pulleys. Then to the same scale the lengths $b\,c$ and $a\,c$ represent the radii of two steps which will work together properly. Draw another vertical $d\,f$, and, similarly, the lengths $e\,f$ and $d\,f$ represent radii of another pair of steps. Likewise, $g\,k$ and $h\,k$ are to the same scale radii of a third pair which will work together correctly. Thus any number of pairs of steps may be obtained by drawing verticals cutting the two curves and the base line $m\,n$.

The diagram should be drawn on finely ruled cross-section paper, so that dimensions may be read without resorting to a scale. The continuous metric cross-section paper published by Queen & Co., of Philadelphia, is very convenient for the purpose. The length BC of the diagram is made just equal to the width of the paper, *i. e.*, 50 centimeters. Since the vertical dimensions are the only ones used, the diagram is correct whatever its horizontal length may be. It is advisable, however, to make $AD = BC = 50$ centimeters. An important property of the diagram may be noted here. Suppose, as suggested above, $AD = BC$: Then at any point the vertical distance between the curves AB and AC is equal to the horizontal distance of the point from the origin A. That is, $gh = Ap$, $rs = Au$, etc. If we should make $BC = 2AD$, then $gh = 2Ap$, $rs = 2Au$, etc.

Suppose the distance between the axes of the pulley is 50 inches: This distance is represented on the diagram by the length $BC = 50$ centimeters. Therefore, the scale to be used is 1 centimeter = 1 inch. Since the paper recommended is ruled to millimeters, the radii of the steps may be read directly to tenths of an inch, and it is not difficult to estimate to the one-fiftieth of an inch. When the distance between axes is not 50 inches, the scale is not so convenient; in fact, the chief difficulty in using the diagram lies in the choice of the proper scale. The method we have employed in such cases may be shown best by an example:

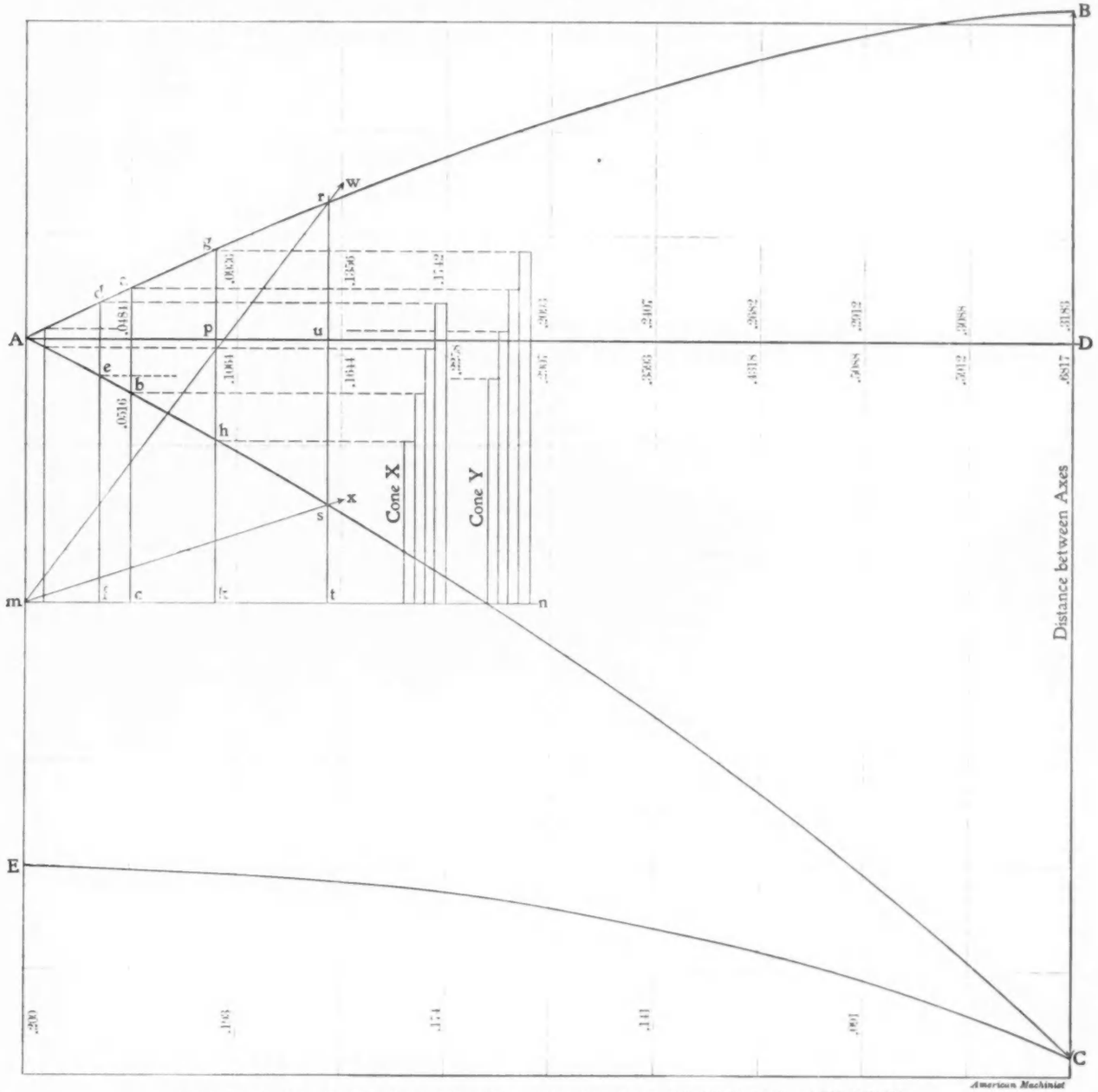
Example: Distance between axes—35".
Radii of steps—Cone X.. 10" 8.5" 7" 5.5"
" " Cone Y.. .. .. 10.5 ..

Required the radii of unknown steps of cone Y.

We have seen that the scale is most convenient when the distance between axes is 50 inches. Suppose, now, we conceive the distance in the example stretched from 35 to 50 inches: If the radii of the steps are made larger in proportion, the size of the cones relative to the distance between axes will be the same as before. In other words, the configuration is simply magnified in the ratio of 50 to 35, and we have changed the given example into another:

Distance between axes—50".
Radii—Cone X 14.29 12.14 10 7.86
" Cone Y..... .... 15 ....

The two steps of known radii are used to fix the position of the line $m\,n$. The difference between these radii is 15" — 10" = 5"; therefore, this must be represented by a vertical distance between the curves $A\,B$ and $A\,C$. On the axis $A\,D$ lay off to scale $A\,5 = 5$ inches. Then, as shown above, $a\,b = A\,5 = 5$ inches. Draw the vertical $a\,b\,c$, and from b lay off $b\,c = 10$ inches, or from a lay off $a\,c = 15$ inches. Then $a\,c$ and $b\,c$ represent the radii of the 15-inch and 10-inch steps, respectively, and a horizontal line $m\,n$ through c is the required base line. Lay off $h\,k = 7.86$ inches, draw line $g\,h\,k$, and the length $a\,k = 16.92$ inches is the radius of the step pairing with the 7.86-inch step. Likewise make $d\,f = 14.29$ inches, and the radius of the other step of the pair is $e\,f = 10.79$ inches. The final results are:



KLEIN'S DIAGRAM FOR DETERMINING RADII OF CONE PULLEYS FOR OPEN BELTS.

Radii of steps—Cone *X*. 14.29 12.14 10 7.86
" " Cone *Y*. 10.79 13.00 15 16.92

These results are now to be reduced in the ratio of 35 to 50; that is, they are to be multiplied by $\frac{35}{50} = .7$. This gives for the actual radii:

Cone *X*.	10″	8.5″	7″	5.5″
Cone *Y*.	7.55″	9.1″	10.5″	11.84″
Sum.....	17.55″	17.6″	17.5″	17.34″

As a rough check on the correctness of the work, it may be noted that the sum of the radii of the steps nearest equal in size is greatest, while the sum of the radii of those most unequal in size is smallest.

In many cone pulley problems the steps are to be designed to give definite velocity ratios. Such problems are readily solved by means of the diagram. Let a line *r t* be drawn intersecting the curves at *r* and *s*. From the point *m* where the base line *m n* intersects the vertical *A E*, draw the diagonal lines *m r* and *m s*. Denote angle *r m t* by θ and angle *s m t* by ϕ. From the property of the diagram above pointed out, we have:

$$r s = A u = m t.$$

Let v = desired velocity ratio:

$$\text{Then } v = \frac{\text{radius of large step}}{\text{radius of small step}} = \frac{r t}{s t},$$

$$\text{or } v = \frac{r s + s t}{s t} = \frac{r s}{s t} + 1 = \frac{m t}{s t} + 1;$$

$$\text{hence, } \frac{m t}{s t} = v - 1, \text{ or } \frac{s t}{m t} = \frac{1}{v - 1}.$$

$$\text{But } \frac{m t}{s t} = \tan.\ \phi; \text{ hence, } \tan.\ \phi = \frac{1}{v - 1},$$

$$\tan.\ \theta = \frac{r t}{m t} = \frac{s t}{m t} \times \frac{r t}{s t} = \frac{1}{v-1} \times v = \frac{v}{v-1}.$$

Therefore, to find the radii of two steps to give a required velocity ratio, draw a diagonal through the point *m*, making an angle whose tangent is $\frac{v}{v-1}$ with the base line *m n*. Where this diagonal cuts the upper curve gives the larger of the two steps. For example, take the same base line as in the problem just solved, and let it be required to find the radii of two steps which shall give a velocity ratio of 4:

$$v = 4$$

$$\tan.\ \theta = \frac{v}{v-1} = \frac{4}{3}.$$

Lay off three divisions from *m* to the right, and then lay off four squares vertically, locating the point *w*. Draw the line *m w* intersecting the upper curve at *r*. Draw the vertical line *r t*. Then *r t* represents the radius of the larger step, and *s t* that of the smaller. As a check we have:

$$\tan.\ \phi = \frac{1}{v-1} = \frac{1}{3}.$$

Hence, lay off three divisions to the right of *m* and one division up, locating the point *x*, and draw line *m x*. This line should intersect the lower curve at *s*. The measurement of the lines gives for the radii 13.36 inches and 3.34 inches, respectively.

By using the tangent method just outlined, all problems involving velocity ratios can be solved with the greatest ease and exactness. It is necessary in every case to express the velocity ratio as a whole number or improper fraction. Thus, if the velocity ratio is given as ⅓, it is to be changed to 3 before using in the formula.

Though the diagram described gives good results, greater accuracy may be obtained by using a larger one. We have obtained excellent results by making the line *A D* 50 centimeters long, as usual (that is, the width of the cross section paper), and the line *B C* 100 centimeters in length. This doubles all vertical dimensions and, of course, permits greater accuracy. When the diagram is thus constructed, it is convenient to consider the distance between axes 100 inches in each case and reduce the radii to correspond. If, however, the axes are very near each other, it may be better to consider the distance between them 10 inches and reduce the radii in proportion. Then the scale of the diagram will be 10 centimeters = 1 inch, and the measurements can be read directly to $\frac{1}{100}$ inch.

Since the vertical ordinates are doubled in the large diagram, the formulæ for the tangents become:

$$\tan.\ \theta = \frac{2v}{v-1}$$

$$\tan.\ \phi = \frac{2}{v-1}$$

Though each size has its advantages, the large diagram is to be preferred, and will hereafter be used in all our work.

G. A. Goodenough,
University of Illinois.

[As the actual diagram is too large for our pages, we have given with it the value of the ordinates (taken from Klein's "Elements of Machine Design") by which it may be laid out full size. The figures give the distances of the curves *AB* and *AC* above and below the axis, as percentages of the distance *BC*. That is, taking the last ordinate but one to the right, and taking the distance *BC* as 100 inches, curve *AB* crosses this ordinate at .3088 × 100 = 30.88 inches above the axis, and curve *AC* crosses the same ordinate at .5912 × 100 = 59.12 inches below the axis. Our contributor has not explained the use of the curve *EC*, and it seems proper to add its purpose here. It is clear that should the line *mn* be low enough on the diagram it will intersect this curve, and in that case the portion of the line below the curve will give impossible results, inasmuch as pulley diameters obtained from that portion of the line will be so large that the sum of their radii will exceed the distance between the pulley centers. The abscissas of this limiting curve are also given, measured from the base line.—Ed.]

The Records of Experience.

"Engineering," London, recently contained a long and thoughtful editorial under the above title. An idea of the drift of it may be obtained from the following sketch:

No progress can be possible to the individual who has no memory, or to the nation that has no records. When trades were "mysteries," and the way of doing things was passed from father to son, or only communicated from member to member within the guilds, no progress was made. The "lost arts" belonged to the age without records.

The technical schools promote the habit of recording, and are teaching men that knowledge is not to be hoarded. Our knowledge, as our gold, we no longer bury unproductive in the earth, but put out to interest to our mutual profit. Not only the profit of a monopoly of knowledge, but also the possibility of the monopoly, is continually diminishing. Knowledge may be hoarded as capital, or it may be put out to get credit, and the latter is far the more profitable. Reputation secured is the surest of all investments. He who has given the most to the world is always presumed to have the most left. Fortune comes after reputation, and the engineer buys reputation with experience.

Experience cannot be hoarded and still retain its full value. The moment of its first discovery is its time of greatest worth, and then is the best time to trade upon it. A man cannot transmit the full value of his experience. If he tell it ever so fully and freely, he is still lastingly richer by the training the pursuit of it has given him.

Physicians and surgeons never make a secret of discovery, and those among them who have the most to tell, and tell it, are still at the head. The value of experience is in the getting more than in the giving. Only for a short time is a technical discovery directly useful. The master-patents that issue are very few. Patent rights are the price paid by the State to secure the records of progress, and the value of the records, not in the books, but in modern life, is incalculable.

The British habit, if it be British alone, of publishing records is deprecated by some, and they would suppress the "proceedings" of the societies. They say that through such means foreigners get their knowledge cut and dried. But it is not a free gift; it is an interchange. It brings trade, and other knowledge also, and all the world is the richer. The man who follows the lead of even the foremost is still somewhat behind. The liberal policy seems to be the winning one.

▲ ▲ ▲

By about 218,000 votes to 175,000 the Swiss Railway Account Bill, which is said to precede the nationalization of the railways in Switzerland, was recently agreed to. This was by a direct vote of the people under the "Referendum."

A New Gage.

We all know something of the gages that are made by machinists out of a piece of wire carefully filed to length, usually with no very clearly defined shape at the ends, and usually left soft, so that the originally small contact surface is soon worn below size if the gage is used much.

The Brown & Sharpe Manufacturing Company having found a demand for some such low-cost gages, have undertaken to supply it with a gage shown in the accompanying engraving, which is full size of the 4-inch gage. These gages

FOUR-INCH END MEASURING ROD—FULL SIZE.

are hardened at the ends and are ground spherical; that is to say, each end is a section of a sphere of corresponding diameter. This not only much increases the wearing surface, but also insures that when the gage is used for measuring between straight surfaces, as in planer or milling machine work, it cannot be cramped, but will act so long as its ends are in contact with the work at all, just the same as a ball of the same size would act.

The ends of these gages are ground by machinery specially devised for the purpose, and they are made in all standard lengths from 3 to 16 inches, those up to 8 inches long being ⅜ inch diameter, and the larger ones ½ inch.

▲ ▲ ▲

Some Notes on Windmills.

BY PROF. DE VOLSON WOOD.

The earliest trace, of which we have knowledge, of windmills for power, was among the Bohemians, as early as 718, but they were not extensively used until the twelfth century.

About 1820, Coulomb made observations upon several Dutch windmills near Lille, in Flanders. They averaged about 66 feet in diameter and had four arms, the sails being about 6 feet wide. With a wind of about 15 miles per hour, it was said they would develop about 6½ horse-power, net.

History mentions a Dutch windmill having a wheel 150 feet in diameter. All these were heavy structures, and of small power considering their size; they are chiefly of historic interest, for they are being displaced by the improved American mills.

Mr. John Burnham, formerly of Connecticut, is the reputed "father of the American system." I am not aware that he is celebrated for inventions, but he engaged in the business, and followed it with such zeal in his early days that his name is necessarily associated with its early growth. Mr. Halliday was the first inventor of the centrifugal governor as applied to the American wheel. Mr. Halliday and Mr. Burnham were associated in the manufacture of these wheels at Batavia, Ill. A prominent characteristic of the American wheel is—the large number of narrow slats. In Halliday's wheel the speed was regulated by turning these slats into or out of the wind, and it is called the "sectional" wheel.

The "Eclipse" windmill was patented in September, 1867, by Leoanard H. Wheeler, who, after serving for twenty-five years as an Indian missionary, accidentally broke his arm, and then took up the invention of a windmill designed for pumping water and grinding corn for the Indians. In the first experiment the mill was destroyed by being blown down from its support by a gust of wind, which incident induced him to make the wheel "solid;" that is, the slats were secured rigidly to the arms of the frame, and adjustment secured by a lateral vane which forced the wheel "out of wind" as the force of the wind increased. He established a manufactory in Beloit, Wis., and organized the "Eclipse" Company, which in one year made some 5,000 mills. Mr. Wheeler died in 1872.

Numerous modifications of the "solid" and "sectional" wheels have since been made, and many manufacturers have engaged in their construction; but the greatest improvement appears to have been made by Thomas O. Perry, a graduate of the University of Michigan, who, after an acquaintance with the business, and as a result of a large number of experiments, constructed a solid wheel which he called the "Aermotor." The improvement consisted first in a simplification of design, and second in the substitution of steel for wood. Of these it has been reported that some 15,000 were made in one year.

The light, open, portable trussed frame of steel for supporting the wheel is an American invention.

To find the efficiency of a wind wheel experimentally, the wheel was mounted on a long arm and forced against still air by rotating the arm. The experiments were made in a large covered area. Mr. Perry kindly furnished me with the results of experiments with three wheels, each 5 feet in diameter. The one marked A might be called a good "stock" wheel, B an improved one, and C an improvement on B. The data and results are:

Mark on Wheel.	Vel. of Wind, Miles per Hour.	Dynometric Resistance one foot from Axis. Pounds.	Turns of Wheel per Minute.	Products at Maximum.	Ratio of Products.	Efficiencies.
A	8.452	1.9	30.67	58.273	1.000	0.142
B	8.452	1.9	38.13	72.477	1.2432	0.176
C	8.451	1.9	56.50	107.350	1.842+	0.261

The computations were as follows: A dynamometer was placed 1 foot from the axis of the wheel and registered 1.9 pounds, which with wheel A traveled 30.67 turns per minute, and as the dynamometer was 1 foot from the axis, the work was:

$U = 1.9 \times 2\pi \times 30.67 = 366.2$ foot pounds per minute or 6.104 foot pounds per second.

The energy of the air was

$$\text{Energy} = \tfrac{1}{2}\,\frac{W}{g}\,v^2$$

in which W is the weight of air passing the wheel in a stream 5 feet in diameter moving with a velocity of 8.452 miles per hour, or 12.3962 feet, or, say 12.4 feet per second.

The weight of a cubic foot of air at 78° F. and 30 in. bar. = 0.0739 pounds.

Area of the wheel = 19.635 sq. ft.

Weight of air passing the wheel per second:

$W = 19.635 \times 12.4 \times 0.0739 = 17.9929$, or, say 18 pounds. Hence,

$$\text{Energy} = \tfrac{1}{2}\,\frac{18}{32.168}\,(12.4)^2 = 43.02 \text{ foot pounds per second, and}$$

$$\text{Efficiency} = \frac{U}{\text{En.}} = \frac{6.104}{43.02} = 0.142$$

Since the velocity of the wind was practically constant, 12.4 feet per second, and also the measured resistance, 1.9 pounds, the efficiencies will be proportional to the number of turns per minute, or as 1 : 1.2432 : 1.842. Hence, for wheel B the efficiency was $0.142 \times 1.2432 = 0.176$; and for C, $0.142 \times 1.842 = 0.261$; or the last efficiency was about 26 per cent. of the energy of the wind. The last is a very high efficiency for a wind wheel. It is a gain of $0.261 - 0.142 = 0.119$ over the "stock" wheel, a gain of $\frac{0.119}{0.142} \times 100 = 84$ per cent. The work of wheel C was $366.2 \times 1.842 = 674.5$ foot-pounds per minute, which is only $674.5 \div 33{,}000 = 0.0204$ of a horse-power, or only $\frac{1}{50}$ of a horse-power. The power increases nearly as the cube of the velocity, and the power will increase nearly as the square of the diameter; hence, a wheel of the quality of C, working in a 17-mile wind, must be about 12½ feet in diameter to produce 1 horse-power, and this larger wheel in a 34-mile wind would produce about 8 horse-power. But wheel C had an exceptionally high efficiency, and hence such a high delivery would not likely be produced in practice.

American Locomotive Pistons.*

The use of cast iron for pistons has been almost universal in this country, principally because they can be easily and cheaply made of this material, and also because of the low cost of maintenance and renewal. Cast iron is not only relatively a weak metal, but the stresses due to uneven contraction in cooling necessarily compel designers to make cast iron pistons stronger than would theoretically be needed to resist only the external forces; also, in spite of the many advantages cast iron has over other iron and steel for piston material, the allowable stress cannot be great. A comparison of the relative strength and cost of mild or soft steel and cast iron would seem to indicate that the substitution of steel, either cast or in plate form, forged or pressed, or perhaps a combination of both, would offer the most practical solution of the problem of how to effect a saving in weight here without unduly increasing cost; and your committee find that much progress has been made in the use of this metal for pistons, and in most cases a large reduction in weight has been the result.

In design, the single plate form seems thus far to have been the most in favor, and undoubtedly this type permits of the greatest possible reduction in weight consistent with a proper degree of strength. For very large pistons for the low-pressure cylinders of compound engines, it is certainly to be preferred to any type that has yet been brought out. Three forms of this kind of piston are made, viz., with central plate, a very good example of which is shown in Fig. 1; the side plate, as per Fig. 2, and the inclined, or Z-form, as per Fig. 3.

A modification of the side plate is heavily dished and provided with a cast iron rim, as shown in Fig. 12.

Although the single plate solid-cast or forged steel piston probably presents the best form for combining strength and lightness, the wear between piston and cylinder, due to the greater co-efficient of friction, presents an objection to its use which it has been sought to overcome in various ways; and further, when the cylinder is worn to such an extent that reboring is necessary, and the piston is consequently too small, your committee could not learn that any satisfactory method has yet been devised for enlarging it, consequently the whole piston must be thrown away. Several plans have been tried for providing the rims of steel pistons with a bearing surface of metal having better wearing qualities and that would be less liable to damage the cylinder than steel. In some instances the surface of the rim has been tinned all over to a depth of $\frac{1}{16}$ or $\frac{1}{8}$ inch, but the tin does not hold well. In the piston shown in Fig. 4 the Richmond Locomotive Works have tried grooving the rim as shown, and then filling the groves with tin, but this was not a success. Brass or bronze has been cast in the grooves putting in a section, allowing it to cool, and then burning or casting on another section, thus providing for shrinkage. This plan has proved more successful, but owing to its necessary limitations, large wearing surfaces cannot be obtained; the wear is consequently rapid, and repairs must be frequently made. In the piston designed by Mr. F. J. Cole for the Baltimore & Ohio Railroad, and shown in Fig. 3, the two packing rings are made quite wide, but while they would possibly better meet the requirements for wear, such wide packing rings are usually considered objectionable.

Fig. 5 shows a Z-plate piston made by the Rogers Locomotive Company, in which the wear seems to be pretty well provided for. It is designed for compound locomotives with 19-inch or 20-inch diameter high-pressure, and 29-inch, 30-inch and 31-inch diameter low-pressure cylinders. These all have a cast iron "carrying ring" *A A*, as shown on their faces. The piston is turned to shape to receive this ring, and the latter bored to fit, sawed through at one place, sprung on and secured from turning by ½-inch copper rivets. The grooves for packing rings are then trued up to size; the edges of the carrying ring *A* furnish in part the bearing for the inner edge of the packing rings. As *A* is slightly larger in diameter than the flange of the piston, at the outer side of the packing rings, the cast steel part will not touch the cylinder until *A* is worn down about 1-16 inch; *A* can then be turned with its worn face to the top by removing the copper rivets and putting in new ones, their holes being drilled by templates to match again when *A* is turned to 180 degrees.

Weight of 20-inch diameter piston, with rod, Fig. 5, 358 pounds; 31-inch diameter, complete with rod, 535 pounds.

Figs. 6 and 7 illustrate a very handsome, strong and light design for cast-steel single-plate pistons, which are used in the Class "K" two-cylinder compound built by the Chicago, Burlington & Quincy Railroad. Eccentric spring packing rings of cast iron are lined solid on the bottom, 12 inches of the circle in the high-pressure cylinder, and 18 inches in the low-pressure cylinder. The low-pressure piston rod is extended through and supported by the front cylinder head. To reduce as much as possible the weight of this extension it is made of steel pipe, which is internally threaded and screwed on to a short extension of the rod. These pistons were designed for 180 pounds steam pressure, and weigh as follows:

	lbs.
Weight 20-in. cast steel piston (Fig. 6)	221
" piston rod	94
" 3-inch nut	5
Total	320

	lbs.
Weight 29-in. cast steel piston (Fig. 7)	395
" solid rod	94
" hollow extension rod	46
" 3-inch nut	5
Total	540

The Pennsylvania Railroad have designed and are using a piston which is shown in Fig. 12, and which is a combination of a single plate, dished in shape, cast or forged steel, and a cast-iron rim secured to the plate by countersunk head screws. The rim is made much the widest at the bottom, where it bears on the cylinder. This design combines the lightness and strength of the Z-plate, with the additional advantages of a good wearing surface and ease of renewal.

One objection to this design is that if great care is not exercised in fitting up the pistons, there may be leakage around the bolts. The rings must be nicely fitted and drilled to jigs, holes tapped and bolts well threaded and made steam-tight. After the bolts are screwed up, they should be tightly riveted, care being taken that they are not loosened in the operation. These pistons have been in service about two years with good results.

The designs in single-plate pistons, which have been mentioned and illustrated, have been made principally for high speeds and high pressures, and are given as good examples of what can be done where it is very desirable to reduce the weight to the lowest possible limit consistent with strength, the question of cost being secondary. With this type of piston, in order that the clearance spaces may not be too great, it is necessary that the shape of the cylinder heads should be made to conform to that of the piston, and it is recommended that the surfaces of pistons and cylinder heads be turned all over, although this is not absolutely necessary, providing the work of casting and fitting up the parts is well done.

There are many who favor the bull-ring type of piston, because they believe that this form, while presenting good wearing surfaces to the cylinders, also enables the wearing parts to be easily and cheaply renewed and repairs quickly made. Also, this type enables the Dunbar or other sectional packing rings to be used; further, with this form of piston, as with the solid piston, it is not necessary to cast irregular-shaped and excessively heavy cylinder heads, and the clearance spaces are more easily regulated. By the use of steel, this type of piston can be much lightened.

Fig. 8 shows a design of steel piston of the bull-ring type which has been successfully used in engines built by the Schenectady Locomotive Works. Referring to the design, Mr. A. J. Pitkin, the superintendent, says: "We make extensive use of the I-section form of piston (Fig. 9) where roads desire solid heads. When the separate bull-ring and follower type of piston is desired, we are using the design shown

* From the report of a committee of the American Railway Master Mechanics' Association, Saratoga, 1896.

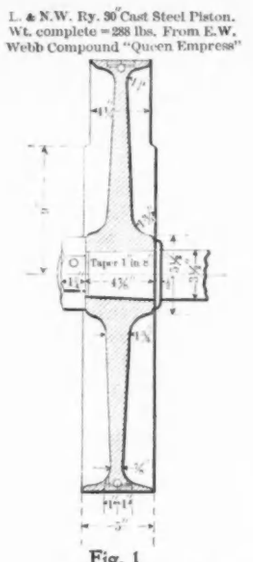


Fig. 1

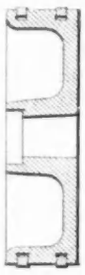


Fig. 2

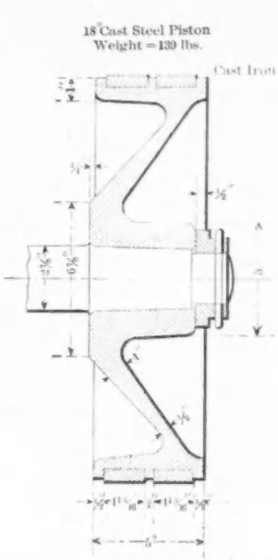


Fig. 3

Fig. 4

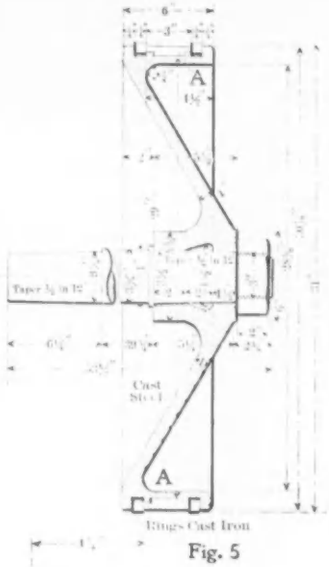


Fig. 5

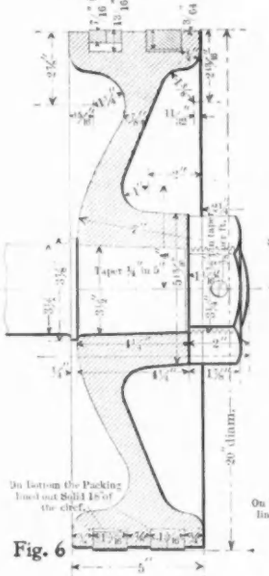


Fig. 6

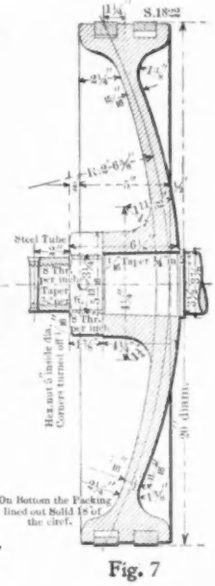


Fig. 7

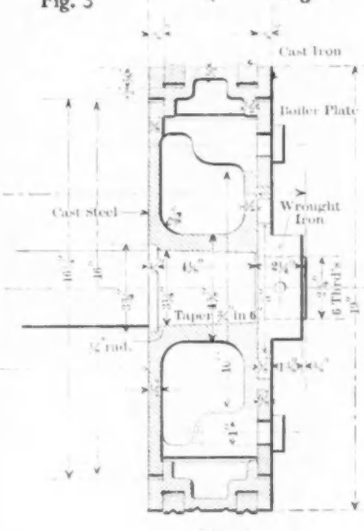


Fig. 8

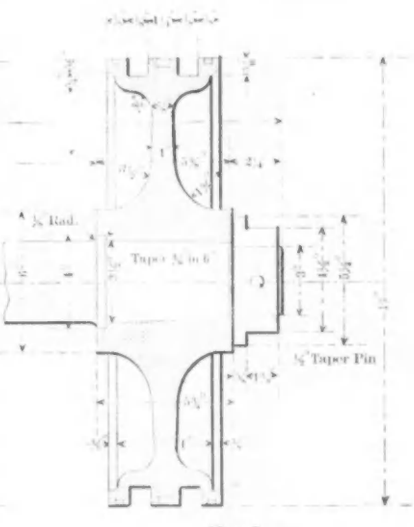


Fig. 9

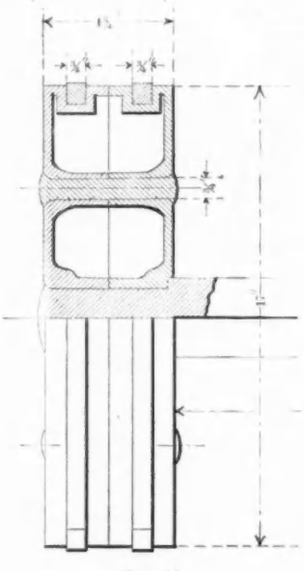


Fig. 11

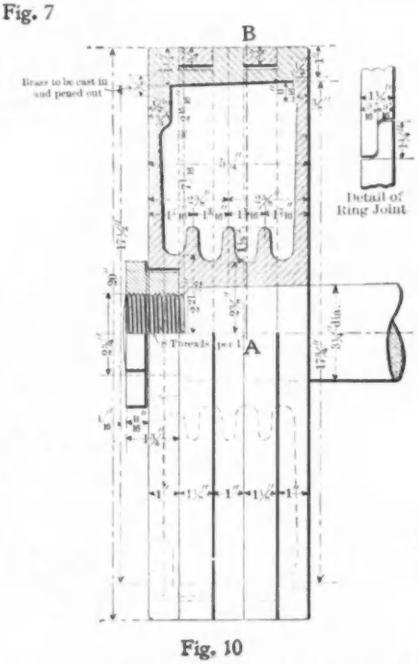


Fig. 10

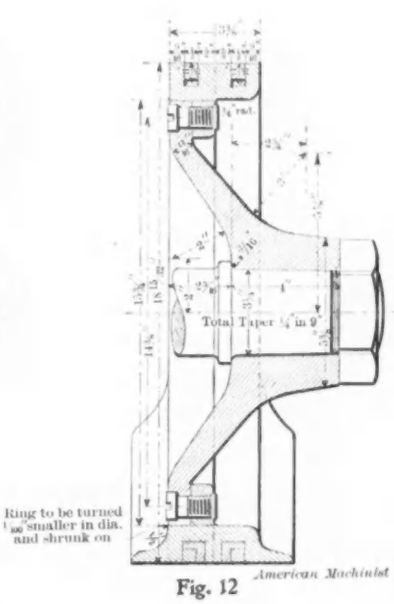


Fig. 12

AMERICAN LOCOMOTIVE PISTONS.

(Fig. 8), making the spider and follower of steel, and we have found this makes a very strong and light piston, and one which gives good satisfaction in service."

The weight of piston in Fig. 8 is 318 pounds, including rod and nut; weight of piston and rod, Fig. 9, 299 pounds.

Fig. 10 shows a 20-inch solid or box piston, by the Norfolk & Western Railroad. This is made of malleable iron, and is very interesting as showing the possibilities of the application of malleable iron in the construction of light pistons. The report of Mr. G. R. Henderson, mechanical engineer of this road, to Mr. R. H. Soule, superintendent of motive power, gives results of a test made of this piston in comparison with a solid cast-iron piston. Report states that pressure was first applied to center of malleable portion to try strength of brass retaining ring, and at seventy-eight tons on wheel press the outer cast-iron wearing ring broke, the malleable iron center being only slightly damaged at the edges. The piston was then put on the wheel drop, supported on a cast-iron ring around the outer edge, and given fifty blows with 140-pound drop falling 12 feet. This merely curled up the edges somewhat, and it was then taken to a casting breaker and given one drop of 5 feet, one of 8 feet, one of 12 feet, and two of 18 feet, when it broke badly. The solid cast-iron piston cracked at ten blows of a 140-pound drop, and went all to pieces on the fourteenth blow, showing that the malleable piston was much the stronger. In service, the pressure tending to force off the outer ring would only be the steam pressure multiplied by the area, about 15,000 pounds, which gives a factor of safety for that portion of about 10. The cast-iron piston weighed 257½ pounds, while the composite weighed but 187½ pounds, a gain of 70 pounds. Mr. Henderson thinks that this type, having shown such remarkable results, can be still further reduced in thickness, thus further reducing the weight, and he expects to make other experiments with this end in view.

Fig. 11 shows another type of malleable iron piston, from the South Carolina & Georgia Railroad. Two of these pistons were placed in a 17 x 24-inch passenger engine about four months ago, and have given good results; have been removed on two occasions for examination and found in good condition, and contained no condensed water. The weight of piston, with rod, is 175 pounds, as against 265 pounds weight of old rod and piston of the bull-ring and follower type. This is a difference of 90 pounds for each piston, a saving that would seem to argue well for the further use of this material.

ELECTRICAL MACHINERY.

Electrical Devices for Changing the Speed of Series Motors.

BY WM. BAXTER, JR.

In many cases where electric motors are used it is necessary that the speed should be capable of variation. This can be accomplished within certain limits in the same manner as with steam engines. As the electric motor is a machine of such great flexibility, it has been believed by many that it could be made to give all desired variation in velocity and thus avoid the complication of mechanical devices. How far this is possible will be shown in the following paragraphs:

The motors now in use are almost without exception of the constant potential type, and are either made series or shunt wound. The series motor will run, naturally, at varying speeds, but the variation is dependent upon the amount of mechanical resistance that has to be overcome; that is, if the load is light, the speed will be high, but if it is heavy it will be low. Furthermore, this change in velocity has a fixed relation to the resistance opposed to rotation. As it is not very often that, in the cases met with in practice, the relation desired between speed and resistance is the same as that given by the series motor, it follows that a change in the load will not be accompanied with a suitable change of speed except in a few instances, and a change in the load must usually be met by the adjustment of some regulating device in order to bring the speed to the point desired.

In the operation of machinery, the variation of the speed desired and the force required to produce rotation is very seldom the same. In some cases, when the speed increases, the force increases, and in others it remains stationary, while in still others it may actually decrease; therefore, any speed-changing device, to meet the practical conditions, must be of such a character that the relation between resistance and velocity is not fixed, but may be varied at will to suit any conditions. These requirements cannot be fulfilled by any method of winding now known; therefore, devices independent of the motor must be used. The simplest of such devices is that shown in Fig. 1.

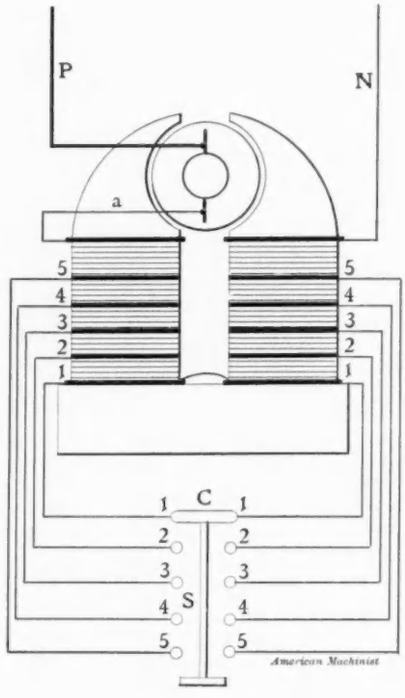


Fig. 1

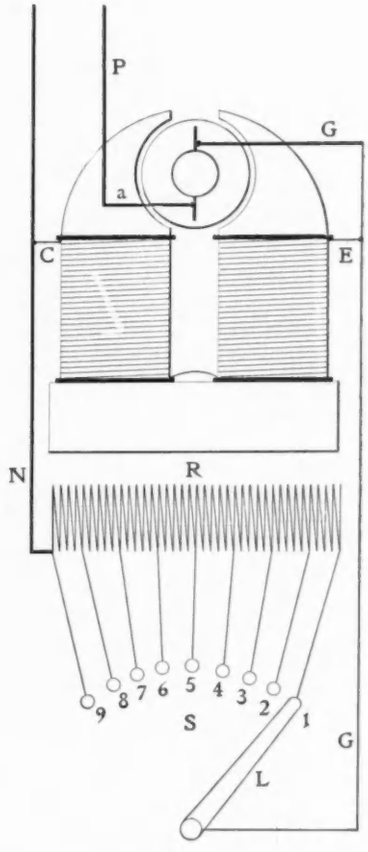


Fig. 2

CHANGING THE SPEED OF SERIES MOTORS.

The principle involved in this is to increase or decrease the strength of the field by throwing into service more or less of the wire wound thereon. To accomplish this, a switch *S* is used, and the contacts 1-1, 2-2, 3-3, etc., are connected with different parts of the field coils, as is shown in the figure. If the connector

C is placed so that it will cover the contacts 1-1, as shown, the current will pass through all the wire, as may be seen by tracing its course from wire *P* to wire *N*. Starting from *P*, the current will pass through the armature, and then, by wire *a*, will enter the left-hand field coil at the top, and, as the wires 5, 4, 3 and 2 lead to contacts on the switch that are disconnected, the only path will be by way of the coil, until it reaches wire 1, and from here through the switch connector *C* to the other coil, and thus to wire *N*. When the connector *C* is moved down so as to cover contacts 2-2, the current will leave the left-hand coil at wire 2, and will enter the right-hand coil at 2, thus cutting out of service the two lower sections of the field coils. Moving the connector to 3-3 cuts out two sections of each field coil; moving it to 4-4 cuts out three sections, and at 5-5 only one section is left on each field.

When this arrangement is used with a constant current motor, the speed can be changed from zero to the highest velocity obtainable, owing to the fact that with such motors the velocity is proportional to the strength of the field, and, therefore, the stronger it is the greater the velocity, and the weaker the field the lower the velocity. To increase the speed of such a motor, all that would have to be done would be to throw more sections of the field coils into service; therefore, the highest velocity would be obtained with the connector covering contacts 1-1, and the lowest when covering 5-5. Constant current motors are not used very extensively at the present time; therefore, we are more interested in ascertaining what the action is with constant potential machines. With machines of this type, the armature has to develop an electrical back pressure nearly equal to the direct pressure of the operating current. This back pressure is dependent upon the velocity of rotation of the armature and the strength of the field. If the field is strong, the back pressure developed per turn will be greater than if it is weak; therefore, the stronger the field the slower the armature will revolve, and the weaker the field the higher its velocity. This action was explained at length in the issue of May 21st. It follows that the slowest speed will be obtained when the connector *C* is in the position shown in the figure, and when it covers contacts 5-5 the velocity will be the greatest.

From the above we see that the best we can do with this arrangement is to increase the velocity beyond that which the motor will give with all the wire on the field in service; but we cannot reduce the speed below this point. This being the case, the motor must be so wound that when all the wire is in service the speed will be the lowest desired, and the higher velocities can be obtained by cutting out more or less of the field coils. As a motor cannot be wound so as to run at very low speeds unless it is made very much larger than is permissible from a business standpoint, it follows that this method of varying the speed is not adapted to cases where it is necessary to run at very low velocities. It may be well to add that the arrangement cannot be used with shunt-wound motors, as in this class of machines the increase or decrease of the number of turns of wire wound on the field does not make any difference in the speed. As the reason for this may not be apparent at a first glance, it may be well to give it here. In motors of this type, as the electrical pressure is maintained uniform, the current strength in the shunt coils is in proportion, inversely, to the resistance, and the resistance is in direct proportion to the length of the wire. If all the turns were wound in one layer, they would all be of the same length; but as this is not the case, the turns on the outside layers are slightly longer than those on the inside ones; but as the difference is small, they may be considered as practically of the same length. From this we can see that the resistance will be directly proportional to the number of turns of wire; therefore, with, say, 1,000 turns, the resistance would be twice as great as with 500. Now, as the current is proportional inversely to the resistance, it follows that with 1,000 turns the current would be one-half as much as it would be with 500 turns; and as ½ multiplied by 1,000 is the same as 1 multiplied by 500, the magnetizing effect in both cases would be the same. Hence, increasing or decreasing the number of turns in the shunt coils will not affect the strength of the field, and, therefore, the arrangement shown in Fig. 1 would be useless in such a case, as its only effect would be to vary the strength of the current in the shunt, and not the strength of the field magnetization.

A very wide increase of velocity cannot be obtained, even in series-wound motors, with the arrangement shown in this diagram, unless the torque is greatly reduced, because when the field coils are cut out the current must be increased if the same torque or rotative force is desired, and the danger of burn-outs puts a limit to this increase of current.

This is one of the most efficient methods of changing the speed of motors, so far as the use of current is concerned; but it cannot be made to give a range of variation of much more than fifty per cent. with good success unless the motors are specially constructed for the purpose, and this is seldom the case. The greater the number of sections into which the field coils are divided, the greater the number of changes in velocity that can be obtained. If a number of predetermined speeds are desired, they can be obtained by properly proportioning the number of turns in each section; but this requires a thorough knowledge of electrical matters, and, generally, in practice the custom is to follow the rule of cutting and trying until the desired speeds are obtained.

Fig. 2 shows another way of varying the speed of a series motor. Its effect is to reduce the strength of the field just the same as the foregoing method; but the result is accomplished by diverting a part of the current from the field, and not by cutting out sections of the coils. As will be seen, the resistance *R* is connected in parallel with the field coils; and by moving the lever *L* of the switch *S* over the contacts 2, 3, etc., any portion of the resistance may be placed in the circuit, and, therefore, nearly all or only a small portion of the current may be diverted from the field. The arrangement is not as good as the previous one, as all the current that passes through the resistance is wasted; on this account the arrangement is seldom used.

It must be understood that, with the series motor, these arrangements will not give exact speeds for each step of the regulator; that is, while one step will give a higher speed than another under the same load, the speed for any step will vary with the load and be higher for a small load than for a heavy one. The action is similar to that of an engine controlled solely by a hand throttle valve; closing the valve will slow the speed, but for any position of the valve the speed will be higher with a small load than with a large one.

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Special Portable Drilling Machine.

We illustrate herewith a very simple and cheap portable electrically-driven drilling machine, devised originally for use in connection with the building of the Pond gun lathe, which we illustrated at length last April. The feed rack of this lathe is located with its teeth vertical, upon the inner edge of the top flange of the bed. A large amount of drilling is, of course, required for the bolt holes which secure the rack in place, and it was primarily for the drilling of these holes that the rig was devised, although, of course, it has found many other applications, as such devices always do.

The limiting condition connected with the work was the fact that in places the clear distance between the flanges within which the machine must go was but twenty-two inches.

The illustration shows the machine at work on the lathe, though not in one of the confined positions. The lathe bed with a section of the rack will be seen at the right, with an angle block bolted to it, to which the operating parts are attached. The motor is supported on the sliding head at *A*, the commutator end passing behind the resistance box shown at the right.

The motor is series-wound, and the change in speed for different sizes of drills is effected by cutting in more or less resistance, there being no change gears between the drill spindle and motor shaft.

This method involves, of course, some waste of current; but the amount of power consumed by such a machine is insignificant at the most; and this method of regulating the speed was found to be preferable to the use of a constant-speed shunt motor, with the complication of a lot of change gears, which in a portable machine would inevitably get mislaid and lost.

The speed of a series motor is dependent not only upon the electrical resistance cut in, but upon mechanical resistance opposed as well, the speed assumed being in all cases a balance between the current and the resistance. The machine will, therefore, race when the tool is removed from the cut, and until the next cut is started, even though it may have been right during the cut. This is not, however, found to give any inconvenience, as the speed will show down as the cut begins, and before any damage to the drill has resulted; while the high speed available under small loads is found to be very convenient for use with small drills.

The series motor was not at first considered desirable for the work; and the machine being intended for a single job, the plan was to fit it with a shunt motor geared to give the speed proper for the size of drill to be used. The series motor was, however, supplied by mistake. It was fitted to the machine to save time, and on trial was found more suitable than the shunt machine would have been, as it gave a flexibility of speed to the outfit which it would not have had if the shunt motor had been used.

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Mr. N. W. Perry, in a recent lecture before the Franklin Institute, compared long-distance transmission of power by electricity and by fuel gas. His claims are that fuel gas offers far greater promises. The advantage lies both in the cost of the pipe, as compared with the conductor, and with the line loss, or power consumed in the transmission. The lecture had reference to the utilization of the culm banks of the anthracite coal region, the conclusion being that their energy could be transported as gas more cheaply than as electricity. Of course, the comparison has no application to the transportation of electric energy derived from water power.

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The telegraph is an institution which does not grow in this country. There has been no increase in the number of messages sent since 1894, which year showed a drop of about twelve per cent., as compared with the preceding year. This result is no doubt due to the competition of the telephone, which now sends about eleven times as many messages as the telegraph. Machine telegraphy, which was bought up and suppressed by the Western Union in the days before telephone competition, is now thought by some to be the means by which the telegraph will be put on its feet again.

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The electric light does not grow in England, the annual report of the English Brush Company making a poor showing. The directors seem to have given up expecting any large development, as they "anticipate that the future demand for traction plant will fully compensate for the shrinkage of orders for electric lighting machinery."

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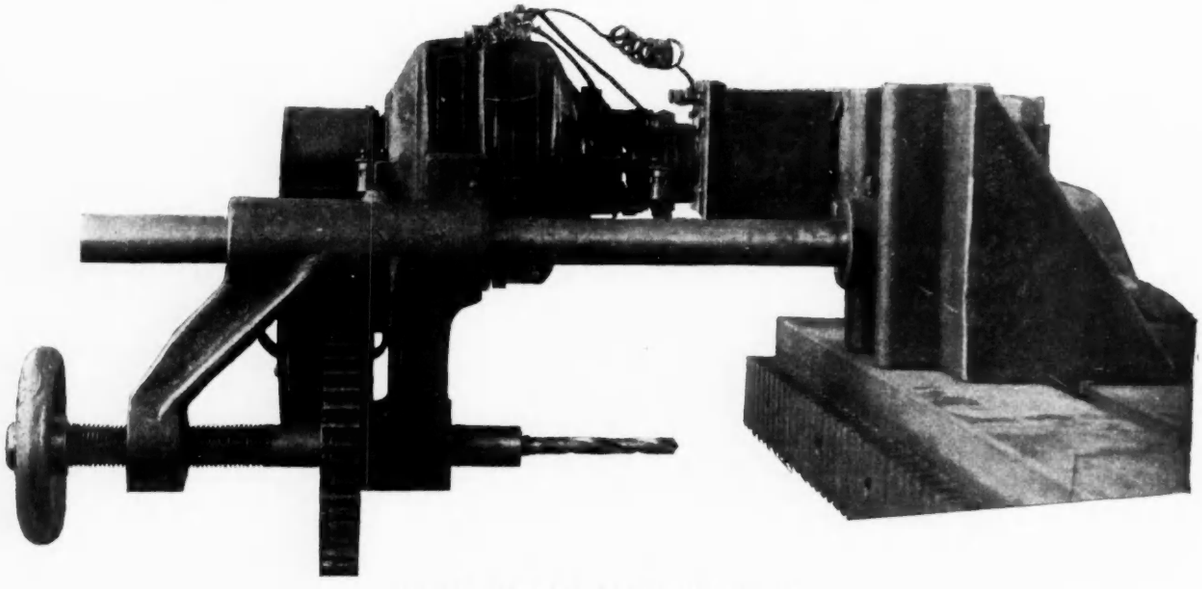
There is a distinct movement toward the revival of vertical engines for large sizes, brought about in the first instance by the necessity of economizing ground room in electric light stations.



SPECIAL PORTABLE DRILLING MACHINE.

Letters from Practical Men.

Hardening Steel in a Gas Furnace.

Editor American Machinist:

Some points in the article on "Hardening," by Mr. F. L. Hubbard, in the "American Machinist" of October 9th, seem to me worth a little further attention. If we will take pains to investigate, we will find that the use of charcoal for steel heating is becoming less where the best results are desired. I know of no fuel for heating steel which is so liable to give a large piece an uneven heat as charcoal.

I think that kind of steel referred to, which will flake "before it reaches an overheated condition," would be a rare curiosity indeed. I am sure I would travel a good many miles on my bicycle to see such a piece of steel, and feel that my effort was well spent.

Again it seems to me that it is "too much contact" with heat, instead of with air, which makes the steel "spotted as if peppered and salted." I trust Mr. H. will write up his process of heating steel with charcoal in a vacuum so that the piece is not "exposed to air."

If Mr. H. thinks he burns out too much carbon from a piece of steel by heating it to any reasonable degree in a gas furnace, I would like to ask him how the steel-maker keeps any carbon in the steel when he melts it in a crucible. I should be inclined to think that Mr. H. has tried gas-heating at some time, and, either from having a poor furnace or from failing to use the same amount of common sense that he evidently would use were he heating in charcoal, the result has been disastrous.

In this connection I would like to say that I have been told many a time that a tool was not overheated when hardened,

because "it is impossible to overheat in that gas furnace." I am sure I do not want to trust a delicate piece of steel or an expensive tool with the man who carries that method of reasoning into his practice of steel-hardening.

A. A. STEELMAN.

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Time Test of Machine Tools.

Editor American Machinist:

I was very much interested by reading a letter from Tecumseh Swift, regarding power test versus time test of machine tools, and I agree with Mr. Swift entirely. As an illustration of his position, in a large shop of which I was recently general superintendent we put in a great many new and modern tools, notably a number of 30-inch planers with backing speed of 3 to 1. Almost all the old planers in this shop had a backing speed of from 1½ to 2 to 1, and the cutting speed averaged about 14 feet per minute, although some one or two were speeded up to 18 feet per minute. I speeded up most of the new planers to a cutting speed of 30 feet per minute, giving, of course, a return speed of 90 feet per minute. I was told by almost everybody about the establishment that the tool steel of which our planer tools were made would not stand being forced through our work, which was mostly cast iron, at this speed. On applying to the maker of the tool steel, he had no fear at all for the quality of his product, or being able to furnish us with brands of his steel which would stand the cutting speed, but, on his part, was very solicitious for the wearing parts of the machine tool itself. I then applied to the machine-tool builder, who assured me beyond any question that his machines would stand being run up to this speed, but that he knew it would be impossible for me to find a tool steel that would stand that cutting speed. However, these machines were started up at this speed and did the work very well.

At the time this was done, one of the planer hands was working by the day and remonstrated very strongly against the excessive speed of the machine. I asked him if the tools he was using showed any indication of being burned by the excessive speed, to which he replied no, but that the cutting of the cast iron at this high speed made such a noise that it could be heard all over the shop. I told him that it was a pity to disturb the quiet of the shop, but I thought the shop would have to put up with it.

One day, by some accident, the pulley which was running this machine got broken, and in our hurry to replace it as soon as possible we used a slightly smaller pulley which reduced the cutting speed to about 28 feet. Shortly after this the workman running this planer was given all his work on the piece-work basis, and although previous to this he had asserted that the planer ran much better at the 28-foot speed, still he had not had the piece-work system in vogue more than a couple of weeks before he was begging to have the larger pulleys substituted so as to restore the cutting speed to 30 feet.

The time element, therefore, in the building of machine tools is one that will prove a very interesting question of study, and will probably return a larger profit for the time spent on it than almost any other one line of thought which the manufacturing manager can pursue. Fifty years ago I think that the machine-shop manager labored under the impression that it was the best economy to so speed and use his machine tools that they would last forever, or if not quite, at least such a part of it as he was most deeply interested in—that is, during his lifetime—not anticipating that any radical changes would be made during that period.

I am very happy to say that I was able to convince our president that the best policy to pursue in utilizing the new tools bought (which, by the way, I think were the first large lot of new tools bought since the shop was started twenty years before) was to run those tools at such a speed as to insure that they would wear out inside of ten years, by which time I assured him that so many improvements would probably be made in this line of tools that they could not afford to keep the present tools in the shop. He readily grasped the idea and conceded that the position was well taken.

As a matter of fact, the work which was turned off on these high-speed tools was much more accurate than that which came off of the lower-speed tools, and the reason of this is, I think, that in the finishing of a piece of work, the sooner it can be got over, the less liabiltiy for the wearing away of the edge of the finishing tool. As a matter of fact, it is about six years since most of these tools were put into operation, and I have no hesitation in saying that if I were equipping another shop at this time, under the same conditions, I should consider that these machines were out of date, and I should most certainly advocate purchasing tools, especially planers, with direct connection to electric motors, mounted direct on top of the main housing, such as you illustrate upon page 25 of your issue of October 15th, being a 60-inch Pond planer at the Homestead Works of the Carnegie Steel Company, directly connected to Westinghouse four-pole compound-wound motors.

I should strongly advise equipping a modern machine shop with electric-driven tools throughout, especially a railroad shop, where a great many of the tools stand idle a larger proportion of the time than in a manufacturing plant, and also for the reason that I believe a number of electric-driven portable tools are rapidly being devised by which repairs can readily be accomplished in any of the roundhouse stalls without bringing the locomotive into the large shop and necessitating a taking-down of the engine.

WM. O. WEBBER.

Boston, Mass.

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Reamers.

Editor American Machinist:

The letter from Mr. Francis W. Clough, in your issue of October 22d, on backing off reamers, leads me to ask why anyone, in this day and age, uses solid fluted reamers at all, when inserted blade reamers can be had? For tool-room or jobbing work, where uniformity of sizes is not of prime importance, the solid reamer can be made to "do"; but for manufacturing operations it has no proper place, as, no matter how made—relieved or not—it is only a question of time when it will lose its size. The inserted blade reamer, with the blades in wedge-shaped grooves, will keep its size indefinitely if properly used; by which I mean that, when dull, the blades should be driven up the grooves, and then the whole be ground down to the original size again. It seems to me that it is time the solid reamer were laid on the shelf, respectfully remembered for the good it has done, but superseded by a tool which is more fully in accordance with the requirements of the day.

I shall, no doubt, be told that the inserted blade reamer will not give the same mirror polish to its hole that the solid tool will do, to which I can only reply that those who prefer a mirror polish to accurate sizes are welcome to the solid reamer, but I am not one of that kind.

C. O. GRIFFIN.

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For Reformed Piping.

Editor American Machinist:

There is much that might be said in criticism of our general piping practice, especially as regards iron piping. Of all our mechanical or unmechanical ways and means, there is probably now none more in need of reformation and improvement. For a quarter of a century, improvements in iron pipe and piping have not kept pace with our general mechanical progress. It is by no means easy to suggest the means by which a better piping system may be secured, or even to show in what direction reform may lie; but I may be doing some service in calling attention to some of the objectionable features of existing practices.

Iron piping is usually employed for the conveyance of water, steam or gas, and no man can guess with any approach to accuracy the length in use. It is recognized as important that the flow of the fluid conveyed shall be as frictionless as possible. Friction here, as elsewhere, must cost something. Either more power is required to maintain the flow or the volume conveyed will be diminished. It is probable that the inner surfaces of the pipes made to-day are smoother and more uniform than the first pipes that were

made; but the break of continuity at the joints remains. The continuous pipe would seem to be as essential as the continuous rail. The passenger can no longer count his speed on a railroad by the rapidity of the joint-thumps; but the couplings on our pipes no one seems to think of eliminating.

No investigation or experiment is needed to convince us that the serrated enlargement of the interior of the pipe at each coupling must greatly increase the friction of flow, and afford a place for sediment and obstructions to fasten and for corrosion to destroy. The thread on the end of the pipe, occupying less than one per cent. of the length of it, still makes it necessary that the entire pipe shall be at least one-third heavier than it otherwise need be for the same service. The couplings or flanges by which the lengths of pipe are continuously connected, enlarging the exterior at intervals, make it impossible to lay pipe neatly or completely, however desirable it may be, at times, to do so.

Now that electric welding has demonstrated its practicability, and is looking for steady and constant employment, it would seem that it could never find a better opportunity of lasting usefulness than by transforming our piping system. Every engineer must recognize the desirability of continuous piping; electricity makes it possible, and it surely must eventually prevail.

Continuous piping would mean the elimination of the commercial elbow. The pipe coupling is bad, and the elbow is worse, and everybody knows it. When pipe-welding had become an everyday and familiar practice, pipe-bending, which is a much easier and simpler operation, would soon be insisted upon. Water or steam or gas will follow a curved course in a pipe of uniform section almost as easily as it will follow a straight pipe, while it always makes strong objection to being driven by the short elbows which are so common. It should no longer have occasion to "kick" on this account.

The pipe tee, as is perhaps not so generally recognized, is worse than the elbow in our piping practice. We have only to think of a column of water flowing rapidly in a straight line, and then a part of it suddenly required to turn off at a sharp right angle to its course, all the while maintaining the rapidity of its flow, to realize what an outrage is perpetrated. A boy playing in the gutter soon learns that water will not shoot suddenly off in different directions, but must be coaxed along by gentle curves. Almost invariably where a tee is used, and where the flow is from the body of the tee out through the branch, the flow in the tee body is constantly in the same direction, and the branch should be led off by an easy curve from that direction, rather than by a sharp right angle. A tee or branch of this character might be secured by electric welding, or a tee made in that shape should be used. Where the supply flows from the branch into the body of the tee, the probability is that it will be required to flow partially or intermittently in both directions, and it should have a divided curve in both directions into the tee. Tees of both these shapes are provided in our present system of pipe fittings, but they are not often used.

If we cannot yet generally have electric welding and continuous pipes, it will be well to keep the possibility and the necessity of it in view. The adoption of long radius elbows and tees will be a move in the right direction, and will make further improvements more easy of attainment.

Our piping system has been peculiarly the victim of the mistaken idea of what constitutes cheapness, perhaps combined with the constitutional laziness of the pipe-fitter. The prevailing consideration all along has been, not what piping and what arrangement of it would be best for the transmission of the fluid—if the fluid would not actually refuse to flow, anything would be good enough, so far as that was concerned—but what piping would be cheapest, and what would be the quickest and easiest connected. If five minutes could be saved here and there in putting up a lot of pipe, no other consideration as to the permanent use of the pipe could possibly outweigh that. Our system of pipe fittings is wonderful, and the fittings are also wonderfully cheap—if you know all about the discounts—but the system never produces a wonderfully neat or satisfactory piping installation. Cheap to put up, and cheap to repair, may in their places be proper considerations; but to be cheap to operate day by day, and to render cheap service all the time, should be the chief recommendation.

TECUMSEH SWIFT.

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Engine Foundations.

Editor American Machinist:

The letter of Mr. Crane's concerning engine foundations reminds me of some experiences of my own along this line which may be of interest. I was once employed to take charge of a plant where the boilers had lain idle for fourteen years, but when the old plant was shut down they had sold the engine, so that it was necessary to buy a new one. When I arrived on the scene the foundation for this new engine was about finished. It was on made land near the harbor, but piles had been driven and a very substantial foundation built for the old engine, which was so located that it had to run "under" in order to turn the machinery in the right direction. The new engine was set so as to run "over," although the same kind of machinery was to be in the mill, and it must run in the same direction as when the establishment was first built. This proves that it was not necessary to run the first engine "under," and it certainly does not add to the good appearance of any engine to so run, and if there is any advantage to be gained by it I have failed to discover it.

The change in location brought the outside pillow block in a new place under which there were no piles, but this seemed to be no objection in the estimation of the owner. This bearing came close to the main wall of the building, which was of brick and about 2 feet thick. The stone work on which this wall rested projected about 6 inches beyond the brickwork, and the pier which was to support the bearing was built on this projection so far as it would answer the purpose, and the remainder of it rested on the made ground. This is shown in Fig. 1, in which *A* is the

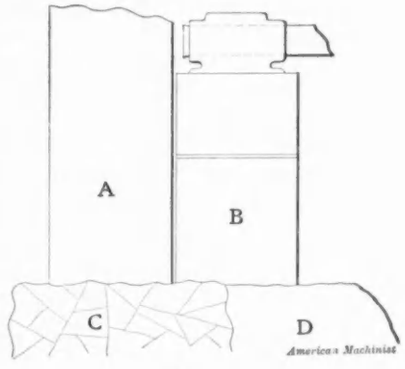

Fig. 1

A BAD SUPPORT.

brick wall of the building, *B* the brick pier, *C* the stonework resting on piles, and *D* the made ground. From this it will be clear that as soon as any weight was put on to the pier the inner portion of it would settle while the outer part would rest on a solid foundation, and a protest was entered accordingly, but to no avail. When the crank shaft and fly-wheel went into place, the settling process was quite visible to the naked eye, and attention was again called to it. The superintendent remarked that "we should have to watch it," and that was all that was done about it.

Well, after the engine was started up I "watched it," and successfully, too, for three weeks, thanks to a good stock of Albany grease and cylinder oil; but at the end of that time I signified my intention of "watching it" no longer, in terms that were not misunderstood. A machinist was called in and two large bolts were ordered, together with two heavy pieces of iron of suitable size to clamp the stone which formed the top of the pier, to the main wall, as shown in the plan, Fig. 2. The crank shaft was leveled, the old sulphur was taken out from under the pillow-block bearing, new was melted and poured in, and from that time forward it needed only a reasonable amount of "watching" to insure a cool bearing.

The specifications for my present plant called for an engine foundation 8 feet deep,

but when that depth was reached, the laborers were in the midst of two cesspools, which made it necessary to go 6 feet deeper, making even a better job than was calculated on by the architect. The foundation was built up with stone until within about 20 inches of the full height, and the whole well grouted. A granite stone longer than the engine frame, of suitable width and about 19 inches thick, was placed in position on top of this, and then jacked up several inches. A body of thick cement mortar shoveled on top of the stonework and the piece of granite lowered onto it, and tamped down with heavy blocks of wood until the perfect bedding of it was assured, and the top surface was nearly level, for it was "winding' to the extent of $\frac{1}{16}$ inch, which was as good as could be expected on a stone that was more than 19 feet long. The bottom of the main pillow block of this engine was planed, and also the support for the cylinder; hence, when put into place, and a strip of iron $\frac{1}{16}$ inch thick put under the low part, it was iron to stone and no

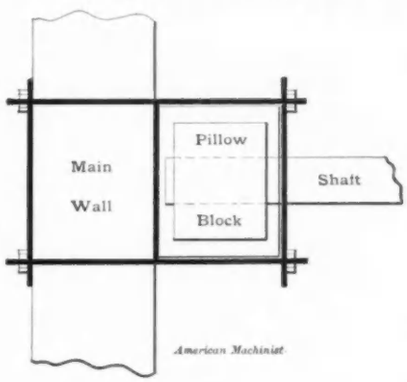

Fig. 2
HUGGING THE STONE TO THE WALL.

discount on a permanent job. I have never seen a more solid foundation than this proved to be.

Three attempts were made to set the stone for the outside pillow block in the same way, but it would not stand solid at the right height, so it was blocked up in position and grout poured under it. This, too, has proved to be a very good job. I give these facts just as I find them, for they show that either plan will answer a good purpose, if properly put in. The small stone supporting the outside pillow block was anchored by bolts about 7 feet long, not built into the foundation, but terminating in pockets with nuts on both ends of them. Where they are made in this way, the upper ends of the bolts may be nicely turned and the length adjusted by means of the nuts, so that the bolts will not have to be cut off after the engine is erected.

Replying to your comment on the name "crank," on page 966, I would say that it appears as if a "cam" travels properly in the course laid out for it, just as a crank does; hence, see no improvement in the proposed change. I always supposed that a "crank" was a fellow whose head was turned.

W. H. WAKEMAN.

New Haven, Conn.

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Influence of the English Banking System on Our Foreign Trade.

An important influence which works in favor of the British manufacturer in his competition with American and other manufacturers is undoubtedly the British system of banking, which is not only much more complete and comprehensive, but also much more closely related to business in other countries than is our own.

At the present time, prices of pig iron, steel billets and many kinds of steel are actually lower in this country than in England; and while steel rails are not regularly quoted lower here, we all know the reason for this, and also know that they can be and are sold in neutral markets at lower rates than English rails are sold. Upon the face of it, this looks as though the foreign business of American manufacturers should grow rapidly at the expense of the British; but this leaves out of account the influence of the British banking system.

It is well known that London is the world's financial center, and when a railway is to build in any foreign country, usually the bonds and the stock for this road are placed in London through banking houses there, which banking houses are likely to have branches in the country in which the road is to be built These banking houses are often more or less intimately connected with British manufacturing concerns, and when negotiations are pending regarding the sale of bonds or stocks, it is, of course, natural that the subject of rails and other supplies should be taken up, and unless there is a very decided difference in price between the English and the American product, the English will naturally have the preference.

It is to be hoped that as American manufacturers become better able to compete with foreign manufacturers, our banking system will enlarge and extend to keep pace with the requirements of our foreign commerce, and it is reasonable to suppose that it will do so; but at present it seems as though it were somewhat behind the actual requirements of the situation, and that as things are now the American manufacturer who seeks to do business in neutral markets, in competition with British manufacturers, is handicapped to some extent.

This, of course, does not apply to all lines of manufactured goods; in fact, Mr. Churchill, of London, states that no effect of such an influence has ever been detected by him in his business of introducing and selling American tools; but it certainly does apply to railroads built in other countries, and to the things needed to equip such roads. Perhaps there is no remedy for this state of affairs until we have much more surplus capital for investment in other countries—capital which can be obtained by projectors of foreign enterprises on as favorable terms as English capital—but it is a matter which might repay looking into.

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Pipe Joints and Fittings.

There is no more striking demonstration of "saving at the spigot and losing at the bunghole" than in the case where cheap materials are used in running a line of steam piping. The false economy is equally conspicuous in hydraulic and compressed air installations; and with the higher pressures now common, much more attention to piping is required if satisfactory results are to be obtained.

Frequently, leaks in flange joints are due to insufficient stiffness in the flange itself, or to improper spacing of the bolts. A thicker flange and a closer pitch of bolts is obviously cheaper than periodically paying for the repair of a defective joint.

There are now so many excellent packings in the market that it is sometimes a little difficult to make a choice; but the principle may be accepted that the stiffer and truer the flange and the closer the spacing of the bolts, the less importance attaches to the kind of packing used. With an ideal flange a metallic gasket is the logical thing, and even a turn of soft copper wire has been known to make a successful joint. An old scheme, still much used, consists in turning one flange with a narrow ring projecting from the face like a gland, this ring being made to enter a shallow groove in the face of the other flange. An insignificant amount of packing at the bottom of the groove makes such a joint tight and durable.

Insufficient spring, or allowance for contraction and expansion, is a fruitful source of leaks and must be remedied by using reliable forms of slip joints or expansion joints, or by introducing bends in the pipe line.

In shore practice, large-size steam pipes are usually of lap-welded wrought iron with screwed fittings, but marine specifications generally call for copper piping brazed to the flanges. Steel pipe with flanges welded on is coming into favor. There have been many serious accidents due to the "drawing" of threaded pipe from the fittings, and the latest practice for large work requires that the end of the pipe be beaded over into a recess provided in the fitting.

It is probable that the thread on large iron pipe could be omitted if the fittings were specially designed to allow the end of the pipe to be expanded with the hammer and the edge turned over into a counterbore. The experiments of Shock in 1877 demonstrated the great holding power of tubes expanded into a tube sheet.

Copper is so susceptible to injury in the fire that it would seem desirable in the case of large piping to avoid brazing whenever practicable. The old process of sweating is not adapted for high-pressure work, as the solder is liable to melt in service. A deep flange (the full width of the joint) could be turned on the end of the pipe itself, and the brass flanges could be used to give the necessary stiffening without being either brazed or riveted to the pipe.

Mr. C. H. Manning has had much success with his riveted steel pipe, the sections of which are slightly conical to give the necessary lap joint at either end. The flanges are forged and are riveted on, the whole being calked steam-tight in the ordinary way. The Manning system might be adopted for marine practice by using sheet bronze and bronze rivets.

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A Russian Railroad Man.

Prince Hilkoff, Russian Minister of Transportation, left for Europe on the steamship "St. Paul," on the morning of the 21st inst., having made a tour of the country with the special object of observing our railway system, to which it seems the prince is not a total stranger, he having worked on railroads in this country thirty-five years ago, with the special object of familiarizing himself with railroad matters and to qualify him for the position he now holds.

He is a very ardent admirer of American railroads, apparently, and states without reservation that our roadbeds are equal to the English, and better than those on the Continent; and that our equipment is better than is found anywhere else in the world. He was, of course, fairly well informed regarding what has been going on here, but yet found much to surprise him in our railroad shops and locomotive building establishments. It is thought that one result of his visit here will be an increased employment of American ideas on Russian railroads, and possibly also an increased trade with Russia among those who have to do with building and equipping railroads.

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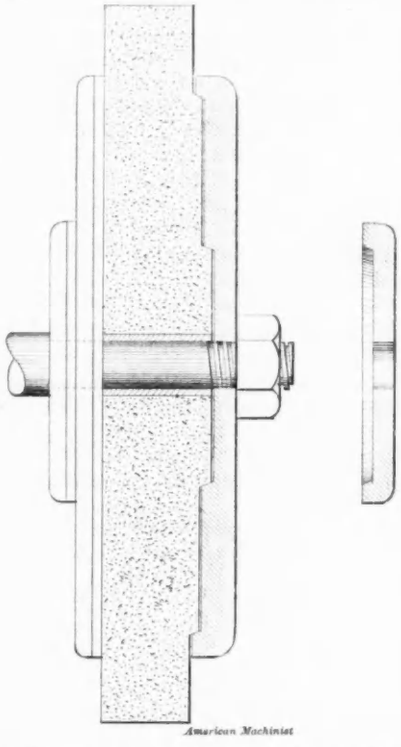
Safety Collar for Emery Wheels.

Anything which conduces to safety in the use of emery wheels is, of course, of interest to those who have to buy or use them, and we illustrate herewith a new form of safety collar which we are informed has withstood satisfactorily some very severe tests. The collar is named, from its inventor, the "Leshure" collar, and the engraving shows it applied to a wheel of relatively large diameter and with two beveled shoulders by which it engages and locks the wheel. When the wheel is reduced in diameter, the smaller collar shown at the right is used instead of the larger one, and in the case of smaller wheels the single smaller collar is, of course, sufficient to meet all requirements. For a 24-inch wheel, for instance, the large collar is 16 inches and the smaller one 8 inches diameter, so that not more than 4 inches projects beyond the collars. The collars are sometimes used on both sides of the wheel, but this is usually not considered necessary.

A 12 x 1½ inch wheel was tested with



SAFETY COLLAR FOR EMERY WHEELS.

one of these collars at a speed of 5,600 revolutions, the listed speed being 1,800 revolutions. It withstood this speed safely, and was afterwards purposely broken and the two pieces clamped together by the collar, in which condition it was run at a speed of 3,600 revolutions, or twice the normal speed, without apparent danger. These collars are supplied by the Hampden Corundum Wheel Company, Brightwood, Springfield, Mass.

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Compressed Air Cars of the Metropolitan Traction Company.

In our last issue we spoke of the air motor cars which have been running in this city for a couple of months past. The cars spoken of are upon a portion of the Third avenue system. There are now also three cars driven by compressed air in operation upon Lenox avenue, which line is a part of the system of the Metropolitan Traction Company, the powerful rivals of the Third avenue, and whose principal line is the Broadway cable. The Lenox avenue line is the only line in the United States operated by the underground trolley, so that the compressed air cars come into immediate comparison with that system, both raising their power, in fact, from the same steam boilers.

A most remarkable fact in connection with the running of the Lenox avenue cars is that a car was run regularly for three weeks, carrying its quota of passengers the same as the other cars, before the public became aware of it, or before it found mention in any of the ubiquitously prying daily papers. The cars are the precise counterpart of the standard cars of the company. The air motors are small engines inclosed in boxes and geared to the axles precisely as the electric motors are. The cars weigh very little more than the electric cars of the same line. The receivers are charged to about 2,000 pounds pressure and the air is reheated before using. The compressor plant employed is necessarily much more economical of steam than the one previously mentioned. It consists of a horizontal tandem compound Wheelock engine, connected to the center of a shaft with a crank upon each end, driving three compressing cylinders in line. Only one set of the compressing cylinders, connected to one of the cranks of the engine shaft, is yet in operation. This part of the plant is built by the Norwalk Iron Works Company. No one is yet authorized to speak of the economy of this plant, or of the prospect of the general adoption of the system.

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A Fast Steam Launch.

When the American liner "Paris" made her last trip from Southampton to this port, she brought a small steam launch which is attracting considerable attention among those here who are interested in such matters. The launch was built at East Cowes, Isle of Wight, by the Liquid Fuel & Engineering Company, and is equipped with oil burner, boiler and engine, designed by Mr. Henry A. House, a well-known American engineer, who formerly lived in Bridgeport, Conn., and has now returned to that place after an absence of several years, during which time he has devoted special attention to the problem of producing high power with machinery of comparatively small weight.

The steam launch referred to is 35 feet long over all, and the same at the water line; 6 feet 2 inches beam, and draws 3 feet at the wheel; her total weight when equipped and ready for a run of 150 miles is 2½ tons. The engine is of the compound vertical type with cylinders 3½ and 8 inches diameter, 6 inches stroke, the normal full speed being 620 revolutions with 250 pounds steam; at which speed and pressure the engine gives about 50 horse-power. The screw is 28 inches diameter, 3 feet pitch. This, of course, is very high power for a boat of that size and results in phenomenal speed, it being easy to make a speed of 16 miles an hour, and it can do this continually, and with no greater danger of breakage or failure of

any part of the machinery than is incident to the operation of any marine engine and boiler; something which can by no means be said for some of the aquatic racing machines or freaks often seen about this harbor.

The company above referred to has built a large number of vessels on this plan at its works in East Cowes, and has supplied them to a number of private individuals and to European governments, some of the latter to be used as dispatch boats and for other purposes in naval operations. Mr. House is here for the purpose of organizing a company to build these boats in this country, and they will probably be built somewhere in the vicinity of New York.

The writer had the privilege of taking a trip on the boat, which is called "The Model," and had an opportunity of observing her machinery in operation. One remarkable point is the very small size and weight of the boiler in proportion to the power which can be generated in it. A single oil burner, which is of entirely novel design, and is supplied with kerosene or residual oil, by air pressure, effects the combustion, and is so arranged that the combustion is equally efficient, regardless of the rate of steaming. In other words, the rate of evaporation can be anything desired, from the slowest to the maximum, without deterioration of efficiency, except that due to the engine itself; and the small body of water contained in the boiler, and the rapidity with which it is converted into steam, makes it possible, and indeed practicable, to control the speed of the engine by the valve which controls the burner, instead of by the engine throttle valve in the ordinary manner. No air is forced to the burner with the oil, but the oil is vaporized in a retort; air pressure being used only to force oil out of the tank and to the burner. This boat, when going at full speed, can be stopped within her own length by reversing the engine, this being of course, due to the proportionately very high power compared with the weight.

She turns within a very small space, and a peculiarity of her behavior is that, when turning at high speed, the boat lists inwardly like a bicycle instead of outwardly as boats ordinarily do.

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The New York State Gun Contest.

We have previously referred to the contest between the makers and inventors of the various guns submitted for test by the board appointed to select an arm for the New York State troops. Governor Morton, it seems has now decided not to accept the report of the commission, and the Savage gun will therefore not be selected as the weapon. Curiously enough, the decision of the Governor seems to rest upon facts which either were known or could as well have been known before the commission was appointed at all, and if the decision based on these facts had been made previously, it would have saved a good deal of expense and bother to inventors and manufacturers of guns, and the State some expense, though this latter may not be a bad investment in view of what has been learned regarding the arms submitted.

In reviewing the matter, Governor Morton states that "executive consideration of this report is not, I think, limited to the mere question of the proper selection of the best gun," and he then goes on to discuss matters entirely outside of the questions presented to the commission, and apparently decides not to accept the report, not at all upon the ground that the commission has not done its work well and satisfactorily, but upon a belief that it is not advisable for the State to at present select or contract for any arm whatever, no matter how meritorious it may be. This decision seems to be based upon the opinion of some of the Governor's advisors to the effect that the arm now used by the troops is better for the service these troops are likely to perform, and upon the alleged fact that the United States Government has on hand about 240,000 Springfield rifles that are available for use by the militia, and that may be supplied to the States as desired if a movement looking to that end which has been initiated turns out to be successful.

Without going into the merits of the contention of rival manufacturers against the Savage gun, it does nevertheless seem to us that they were somewhat hard driven for arguments against the gun when they claimed that the Savage gun was not an American product within the meaning of the law, because at the time Mr. Savage invented it he was a subject of Great Britain and did not become a citizen of this country until afterward, notwithstanding the fact that Mr. Savage's work was done here and the gun was made in this country. It is true that this argument is in accordance with the lawyer's usual methods, but it would seem to a plain ordinary mechanic that when such an argument is brought forward it indicates the lack of more substantial ones.

As bearing on the merits of the case, it may be interesting to note that the Winchester gun has, we are informed, never been selected or recommended for adoption by any army board. This does not, of course, prove that it is not a good gun, but it does seem to show that it it is not well adapted for a military arm, or at least that such is the unanimous opinion of every examining board to whom it has been submitted. The makers of this arm have been most prominent in contesting the report of the commission; the net result of which contest seems to be that no gun award will be made.

It certainly looks, upon the face of it, as though Governor Morton's action and the reasons given for it are nothing more than an attempt to evade responsibility, and that the report of a commission appointed by himself under a law which had received his approval as executive, should have had its report either accepted as satisfactory or rejected upon a basis of faults or shortcomings for which the commission itself or its members could have been held responsible. To go entirely outside the grounds of the contest for reasons why the report should not be accepted, seems to us not to be fair either to the commission, the gun men or anyone else interested.

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School Draftsmen.

Is there any mechanical school in existence which turns out students capable at once of taking positions as competent draftsmen, and is there any reason why they should not bring their students to that degree of proficiency? The art of showing the construction of machines on paper is one of the simplest imaginable. It is hard, in fact, to understand what there is about it to enable the schools to make so much ado over as they do. We cannot understand what there is to teach about making straight lines with a ruler and circles with a compass. The art of projection and the various problems of descriptive geometry which form the foundation of mechanical drawing are, of course, subjects of intellectual study; but the "art" of drawing is scarcely worthy of being called an art at all. And yet, simple as it is, we think the first experience of most school draftsmen is one of humiliation at their own inefficiency.

We are led to these remarks by the recent experience of a young man himself from the shops, and with the mechanical habit already formed—who, after a year's work in one of the most pretentious industrial institutes in this country, put in his recent vacation at making drawings in a nearby machine works. At the end of the vacation he had come to feel very loth to give up his position and return to school. Why? Because, in his own words, he "had learned more in three months' experience than in the entire year at school."

Now, we maintain that there is something radically wrong when, as a mere incident to earning his daily bread, a young man can learn more in three months in a shop than in a year at school, where he devotes his entire time to study for the sole purpose of learning. Moreover, we can see no reason for it. Nor can we see any good reason why the schools cannot turn out men who are fitted to at once take positions—not as designers, of course, but as useful and efficient draftsmen.

When we consider the many highly efficient draftsmen who are such by mechanical intuition and without formal instruction, we can only conclude that there is something lacking in the schools which fail in teaching an art which so many learn without help.

American Machinist.

Published every Thursday
by the
American Machinist Publishing Co.,
256 Broadway, New York.

Angus Sinclair, Pres't. John A. Hill, Treas.
C. A. Hansmann, Sec'y.
C. P. Day, Manager Adv. Dept.
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Planer Speeds.

We publish in another part of this issue a letter dealing with the subject of cutting speed of machine tools, especially planers.

When a planer is to be used on one certain kind of work continuously, it ought to be, and usually is, possible to speed it at such a rate as to give the maximum production; but the speed of most planers must be a compromise, and must be either too slow or too fast for the best results on a large proportion of the work it has to do.

Where castings are soft, and light cuts only are to be removed, it is perfectly practicable to use a cutting speed of 30 feet per minute if good tool steel is used and good tools are made out of the good steel. But if castings are hard, or if they are large, and heavy cuts are to be removed, then better results in point of time are secured by a slower speed with relatively heavy feeds.

It is a quite common experience to see one planer hand use feeds twice as coarse as another. This is exactly equivalent, in point of time efficiency, to doubling the speed of the planer, and it is quite often entirely practicable to double or even treble feeds where any corresponding increase of cutting speed would be out of the question.

When we have in general use some means of varying the speed of planers at will, then the best results can be obtained from each job, the same as is now done approximately with lathes, milling machines, etc. We believe the times will soon demand such means of controlling the speed of planers used for a variety of work, and in the meantime we feel quite certain that no fixed rule for speed can be given. A few planers should not run more than 10 feet per minute, many of them should not exceed 20, while many others may be run at 30 or more, depending upon circumstances.

As to the effect of speed upon the accuracy of planer work, which is also referred to in the letter mentioned above, we should say that if nothing but accuracy were to be considered, a slow cutting speed should certainly be used; but it has long been an established fact that very fast feeds on finishing cuts conduce to accuracy, simply because a given amount of metal is removed by the employment of correspondingly increased amount of tool cutting edge, or, in other words, a given amount of chip-removing work is distributed over a greater amount of tool cutting edge, which enables the tool to maintain its cutting edge in good shape for a correspondingly increased amount of work.

High speed cannot, so far as we can see, have any such effect, and we are inclined to think Mr. Webber's fast machines made work more accurate simply because they were better machines, perhaps also better set, and were not run sufficiently fast to prevent the finishing tools holding their cutting edges long enough to get over the surface planed.

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The Bates Thermic Engine.

We are in receipt of a pamphlet advertising the Bates thermic engine, of Philadelphia, which deserves notice. This is a gas engine of French design, of which we have had knowledge for some time, and in which we have been very much interested. It is of considerable size (100 horse power) and is apparently a serious effort toward the improvement of the efficiency of the gas engine. It has many interesting features in its mechanical details as well as in its scheme of operation, which abandons the Otto cycle entirely. Of course, experience alone can determine its value, but we had hoped that it would be worked out and its real worth determined in a rational manner.

We are therefore disappointed to find that the promoters of the enterprise have apparently organized a company, not to sell engines, but to sell stock. The company controls the States of Pennsylvania, Delaware and parts of New Jersey only, and yet it is authorized to issue five million dollars of stock, one-half of which is offered for sale to the dear public at twenty cents on the dollar.

The pamphlet in question consists mainly of a report of a test of the engine by Mr. Thos. Pray, which shows a consumption of one pound of coal per I. H. P., or 1.2 per B. H. P. This is one encouraging result, though it is no lower, in fact not as low, a consumption as has been obtained with other gas engines. It is certainly no foundation for Mr. Pray's conclusion that "your engine is the nearest approach to the dream of scientific men of many years, by which the energy in the coal was to be directly applied to the production of power," which statement may be set down at once as ridiculous.

We have not seen the prospectus of the company, but understand from reliable sources that it promises a saving of 80 per cent. of fuel over steam engines. If this be taken as referring to the best steam engines, as it is no doubt intended to be read, it is, of course, absurd, and we doubt very much if any subscription to the stock on such a prospectus could be collected or held after being paid.

The most remarkable thing about the new company, however, is the fact that engineers of ability and standing appear as its officers and directors. Thus, the president, Mr. Russell Thayer, is chief engineer of Fairmount Park; the vice-president, Mr. A. E. Kennelly, is a manager of the American Institute of Electrical Engineers; while Director E. J. Houston is an electrical engineer of the front rank. None of these men, however, are mechanical engineers.

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We are not much given to making big promises, but we don't mind saying that we intend some day to publish an article which will be a real novelty. It will be on the advance in skill of machinists, and will nowhere even refer to that letter written by Watt "to a friend," about not being able to get a half-crown piece between piston and cylinder.

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The water glass on the boiler of Mr. House's steam launch, referred to elsewhere, is put on upside down; that is to say, the cock by which it is blown out is at the top of the glass instead of at the bottom, so that the glass is blown out by water instead of by steam, and the result is that the glass is kept much cleaner than when steam is used.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(186) T. C. G., Cleveland, O., asks: Can you tell me how rust stains can be got out of my "biled" shirts? A.—Dissolve a level teaspoonful of oxalic acid in half a tumbler of water, and wet the spots with the solution, renewing the application until the spots disappear, and then rinse in clear water. Finally, sponge with dilute ammonia—a teaspoonful of "household" ammonia to half a tumbler of water—and allow it to dry. The oxalic acid is poison.

(187) H. L. J., Memphis, Tenn., writes: What is a reasonable load per square inch

of bearing surface on crank pins and shafts at different speeds? How much of the circumference of the pin or shaft is usually taken for the bearing surface? We have some bearings as follows: Crank shaft, 9 inches diameter, 6 inches long; load on same, 170 pounds pressure, on a 14-inch diameter piston. Now, 14 inches diameter gives 153.9 square inches area, and $153.9 \times 170 = 26{,}163$ pounds, as the total load at discharge. These proportions seem to be all right for the pressure and speed given above, but when that is exceeded they wear considerably. A.—In computing the distribution of pressure on crank-pins or journals, the surface is usually taken as the diameter multiplied by the length, which is a little less than two-thirds of the actual surface subjected to pressure. The pressure should not exceed 500 pounds per square inch of surface thus computed. In this case we have $9 \times 6 = 54$ square inches, and $26{,}163 \div 54 = 484$ pounds pressure per square inch, so that it is within the limit, while the number of revolutions is only about one half what is common in marine practice where the above rule is used. It is the common experience, that short bearings are more apt to heat than longer ones, if no other conditions come in to modify the result, and in this case the bearing seems to be very short. We infer that the above pressure of 170 pounds per square inch at discharge applies to a compressing cylinder, and if so, then the full pressure would only occur at the end of the stroke. If the cylinder is vertical, of course the weight of the shaft and what it carries, and of the reciprocating parts, should be added to the total pressure. Probably more attention should be given to the lubrication: not merely to the quantity or quality of the oil applied, but also to the place at which it is applied. See article entitled "Machinery Bearings," page 803 of the present volume.

(188) A. G. B., Louisville, Ky., writes: Can you give me a rough-and-ready rule for approximating the horse-power of a steam engine? I am associated with a fellow who has a very quick way of doing it, and I can't quite catch on. A.—We can give a rule that will certainly be rough enough, and its readiness will depend upon the user, the same as with any other tool. We have to assume that the boiler pressure, the diameter of cylinder and the piston speed are known. Multiply the gage boiler pressure in pounds by the square of the cylinder diameter in inches, and this product by the piston speed in feet per minute. Discard all decimals and cut-off three figures from the right, then divide by 84 and the result will be the horse-power. Say that our boiler pressure is 100 pounds, cylinder diameter 20 inches and piston speed 500 feet per minute. Then $100 \times 20^2 \times 500 = 20{,}000{,}000$. Cutting off the three right-hand figures and dividing as directed, we have $20{,}000 \div 84 = 238$ horse power. This result gives a mean effective pressure in the cylinder of 50 pounds, or one-half of the boiler pressure. By the regular method of computation with this M. E. P., the operation would be like this: $20^2 \times .7854 \times 50 \times 500 \div 33{,}000 = 238$. One-half the boiler pressure is about the mean effective pressure obtained in the cylinder when cutting off at one-quarter stroke with the common boiler pressures of, say, 80 to 100 pounds. The above rule may be made still rougher and readier, and, if judiciously used, even handier. Multiply together the boiler pressure, the square of the cylinder diameter and the piston speed, as directed above, cut off *four* figures from the right hand, instead of three as before, and divide by 9 for a Corliss or other automatic non-condensing engine, or by 7 for a common slide-valve engine. Say that we have a Corliss engine 18 x 42 inches, running 60 revolutions per minute with steam at 80 pounds: The operation will be, $80 \times 18^2 \times 420 = 10{,}886{,}400$, and $1{,}088 \div 9 = 121$, nearly. Say that we have a common slide-valve engine 12 x 24 inches, running at 120 revolutions per minute with steam at 75 pounds: Then, $75 \times 12^2 \times 240 = 2{,}592{,}000$, and $259 \div 7 = 37$.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 14.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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Fabric for Bicycle Tires—Testing Tubes.

Mr. C. D. Rice, who is assistant superintendent of the Pope Manufacturing Company's shops, in discussing the subject of tires for bicycles, and other matters connected with the manufacture of these machines, referred to an interesting development in connection with weaving fabrics. Mr Rice was one of the earliest experimenters on tires, and one of the earliest and most persistent advocates of what is known as the hose-pipe tire, his belief being now that this will eventually be the only recognized tire. Regarding the fabric, he stated that it had been found by experiment that a linen fabric, excellent for any other purpose, and, in fact, the best of its kind, has been found almost useless for a tire, because the rubbing which took place between the fibres of the fabric caused them to destroy each other, the character of the fibres being such that this action would inevitably take place. It was finally found that Sea Island cotton was the only fabric which would stand this rubbing action without self-destruction, and fabric made from this is now recognized as best for the purpose.

If a square foot of ordinary cloth is cut out, and threads are unraveled from it, some running in one direction, and the other in the opposite direction, it will be found that when these threads are stretched out straight, those which had lain in the one direction in the cloth will be from one to two inches longer than those which had lain in the other direction, the reason for this being that what is known as the warp is usually kept taut during the weaving operation, while the filling is not stretched, and consequently is considerably longer than the width of the piece being woven. When such a fabric is submitted to any strain, such as would be imposed, for instance, if a circular piece of it were cut out, supported evenly all around the edge and loaded in the middle to the point of rupture, the threads running in one certain direction, that is, those which formed the warp, will always break first, and, in fact, will break before the others are stretched tight, or begin to help support the load.

When this difficulty was encountered, it was found that there were no weavers or manufacturers of cloth to whom such a problem had ever been presented; no cloth, so far as could be found, had ever been submitted to such tests, and it was an entirely new discovery regarding woven fabrics. The difficulty has been overcome, though we do not know precisely by what means, and it is now possible to obtain a fabric in which threads cut from a square piece will have practically exactly the same length, no matter which way they run, and such a cloth is probably about twice as strong as when only one-half the threads can bear the load. It is thought that the same principle applies to sail cloth, but, so far as is known, no requirements of this kind have been imposed upon makers of such cloth, and it is possible that even in the Navy, where we should naturally expect such matters would receive attention, it never actually received attention in the days when sail cloth, and especially its strength, was a very important matter.

Regarding the tubes for bicycle frames, Mr. Rice gave as his opinion that nickel steel would eventually be recognized as the best possible material for bicycle frames. Their method of testing tubes is to put a section of the tube to be tested in a lathe, gripping one end in the chuck and supporting the other in a ball-bearing. A bearing is then placed in the middle of the section of tube, also provided with balls to reduce friction, and this bearing is made to deflect the tube a certain amount, depending upon diameter and gage. A revolution counter is placed at the extremity of the tube, and it is started in motion and allowed to run until it breaks. While running, it requires no attention; but when it breaks, the revolution counter, of course, stops, and shows how many times that tube has been deflected before failure. It is found there is a great difference in the endurance of various kinds of tubing when submitted to this test; but the nickel steel is so much better than any other tubing tried that it is thought scarcely worth while to consider any other. Another advantage it possesses is, that its strength is not so much lessened near the joints by the brazing process, as is the case with other kinds of steel.

Polishing Aluminum.

Aluminum will take and retain a very high polish—fully equal to that of silver. The truly distinctive and beautiful color of aluminum is best brought out in a highly polished plate. Aluminum can be polished on a buffing wheel with rouge, the same as brass; and for polishing any considerable quantity of sheet this, of course, is the most economical way. In the absence of any special aluminum polish, several of which are on sale, the ordinary cold brass polish will be found quite efficient, if it is ground fine enough. "Acme Polish" has earned a well merited reputation in America; it consists of the following materials: Stearic acid, 1 part; fuller's earth, 1 part; rottenstone, 6 parts. The whole ground very fine and well mixed. Use a fine white polishing composition, or rouge, or tripoli, and a sheep skin or chamois skin buff, although it is often polished with an ordinary rag buff. A steel scratch brush run at a high speed will give a high polish to sand castings, and will remove any yellowish streaks that may have been produced by too hot metal. A fine brush gives a most beautiful finish to sheet metal or to articles manufactured from the sheet. By this means a frosted appearance is given to the metal—an effect in many cases equal to that given by a high polish. Remove the grease and dirt from the plates by dipping in benzine. To whiten the metal, giving a beautiful frosted surface, the sheet should be first dipped in a strong solution of caustic soda or potash. This solution should be strong enough to blacken the metal. The plates should then be dipped in a mixture of two parts of strong nitric acid and one part of strong sulphuric acid; then in a solution of undiluted nitric acid; afterward in a mixture of vinegar and water, and finally washed thoroughly in water and dried as usual in hot sawdust. For burnishing, use a bloodstone or steel burnisher. For hand burnishing, use either a mixture of melted vaseline and kerosene oil or a solution composed of two tablespoonfuls of ground borax dissolved in about a quart of hot water, with a few drops of ammonia added. For lathe work the burnisher should wear upon the fingers of his left hand a piece of canton flannel, keeping it soaked with a mixture of melted vaseline and kerosene, and bringing it in contact with the metal, in order to supply a constant lubricant. Very fine effects can be produced by first burnishing or polishing the metal, and then stamping it with polished dies, showing unpolished figures in relief. In spinning or turning aluminum, plenty of oil should be used to prevent the clogging of the tool, and to make it cut smooth in the turning, and to assist in the spinning.—"Aluminum World."

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James H. Greathead, the famous English engineer, upon whose system the London underground railway tunnels were constructed, and whose system it was proposed to employ in the construction of the Broadway tunnel railroad in this city, died on the 23d inst. The system of underground railways, for the success of which Mr. Greathead is chiefly to be credited, is being greatly extended in London, and Berlin has adopted a system of underground intramural railways based upon the same system, while it is said that Paris has also accepted plans for a similar construction. Although Mr. Greathead has never been in America, he was very well known here, and was associated with Sir Benjamin Baker as consulting engineer on the Hudson River tunnel plans.

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Mr. Rhys Jenkins, of London, England, in a private letter states that he had intended to write us something regarding the matter of the inventor of the slide rest, which was discussed in our columns some time ago, but was prevented at the time by pressure of other work. He states that, as he remembers it, Mr. Chadwick doubted that the drawing shown by Gregory, and reproduced in Mr. Durfee's article, really represented the slide rest as made by Maudslay. Mr. Jenkins says that there is no doubt that it did represent Maudslay's slide rest, however, and that he imagines there are a good many lathes with these slide rests scattered about the lumber rooms of English country houses to this day.

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In the absence of live rabbits, the Presidio Club inaugurated a new sport which is quite likely to supersede the original game. It is the running of a stuffed hare by the dogs. To do this, an inverted bicycle with the tire off one of the wheels was located at one end of the field. A string, wound around the tireless wheel, stretched 125 yards off, where is was tied to a stuffed hare. The "winder" or wheelman waited for the signal and began turning the wheel so as to haul in the string and the rabbit, which the dogs tried to overtake. In one instance only did the terriers reach the game.—"San Francisco Call."

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On October 21st the Supreme Court Chamber at Washington was made to look like an air-brake instruction car, this being due to exhibits made by counsel in the case of the Westinghouse Air Brake Company and Geo. Westinghouse, Jr., versus the Boyden Power Brake Company and others. The Westinghouse Company claim that their inventions have been infringed by other makers, and in order to make the matter more clear to the judges, air brakes were set up and put in operation within the chamber.

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George W. Baker, a pioneer manufacturer of sewing machines, at Brattleboro, Vt., and at Hinsdale, N. H., died at the former place on the 23d inst., at the age of 62 years.

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Commercial Review.

NEW YORK, SATURDAY EVENING, OCT. 24TH.

ENGINES AND BOILERS.

As the election approaches, buyers show a reluctance to have anything to do with the market until public issues are settled. Orders are in sight which must wait till after that event. And yet the undertone is good. Six months ago such a cessation of trade as we are having at present would have been deplorable indeed, but now it is nothing to worry about. Confidence is so manifestly returning to general business that prospects are bright, and, as we hope and trust, they will in a few days be ready to ripen into fruition.

Steam goods ought to feel a business revival this fall at an early stage. It is just the season when they are needed, and people who have been waiting, and trying to get along with their old engines and boilers, will have no excuse for further delay. The suggestion is made that the class of engines most materially affected, at first, by the improvement will be the cheaper ones, on the theory that those who have wanted high-grade engines for running dynamos, etc., have gone ahead and bought them with less hesitation than the shops, etc., requiring a lower grade of goods. There is some plausibility in this view, although it would seem that people ought to be more willing to pay for a good thing in the future than they have been in the past. Probably the forward movement will be restricted to no particular class of engines.

STEAM GOODS FOR LOCAL BUILDINGS.

Among recent sales that have been made for New York City purposes are two reported by the Babcock & Wilcox Company: For the new Astor House, 2,300 horse-power of boilers; for the Commercial Cable Building on Broad street, 600 horse-power. It may be mentioned right here that the Solvay Process Soda Ash Company, of Syracuse, have placed a contract for 2,300 horse-power of B. & W. boilers, following one for 2,500 horse-power three or four months ago. That the Solvay Process Company are going on to extend their work in this way, in spite of political surroundings, is a good sign.

The contract for the engines for the Commercial Cable Building, two of 250 horse-power each, has been given to B. Payne & Sons. The new Astor House has been intending to get some Corliss engines, of which we have not yet heard that the order has been placed. It is reported also that some Corliss engines will be needed for Columbia College. The business in steam plants for urban buildings is less affected, at this time, by the uncertainties of election than are some

(Continued on page 37.)

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription list**, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—Position by an experienced layer out in boiler works; married. Box 113, AM. MACHINIST.

Compt. draftsman wants position; exp. in designing engs., boilers, genl. machy. E. P., AM. MACH.

Experienced mechanical draftsman wants position; best references. Box 124, AMER. MACHINIST.

Wanted—A first-class die and tool maker wants position in charge; best of reference. Box 123, AMERICAN MACHINIST.

An up-to-date machine shop foreman wants to change his position; well recommended. Address Box 119, AMERICAN MACHINIST.

Wanted—Position as foreman of machine shop by man of experience and ability; can furnish best of references. Address Box 122, AM. MACHINIST.

Wanted—Foreman for machine shop; medium weight machinery and jobbing; state experience and expectations. Box 120, AMERICAN MACHINIST.

Mach'st, also drftsmn., with elect. knowledge, desires pos. in mach. or elect. factory; German; speaks little English. G. W., 1026 Lawrence st., Phila., Pa.

Mechanical draftsman, experienced in shop and drawing room, general and power transmitting machinery, wants position. Add. Box 117, AM. MACH.

A technically educated machinist, 2 years as machinist, 3 years as designer, seeks employment; unable to speak English. Address Carl Albrecht, care Franz Mayer, 536 E. 87th street New York.

Practical mechanic, experienced machinist and draftsman, well up in devising tools and systematizing methods for doing work accurately at the lowest cost, desires to change. Box 100, AM. MACH.

Experienced mechanical draftsman, 25 years of age, graduate of a technical college, with 5 years' experience in designing machinery, wants position. J. S., care German Technical Society, Phila., Pa.

Have 10 years' experience as foreman pattern maker on general machinery; can make close estimates and handle men to good advantage; would like to correspond with good firm wanting such a man. Box 109, AMERICAN MACHINIST

A thorough, competent bicycle foreman desires position as superintendent; capable of designing special rigs, tools, etc., to facilitate work; sober, reliable and a good manager of men; present employment; no hurry. Box 116, AMER. MACHINIST.

Wanted—A first-class iron foundry foreman, not over 35 years old; must understand soil pipe fittings and general jobbing work; must be a live, energetic man and furnish A1 references; a fine opening for a man of this kind. Box 121, AM. MACH.

Superintendent; one who thoroughly understands modern mach'y and has had exp. in the manf of hardware specialties, and should have a knowledge of tinning, japanning, bronzing & electro-plating in nickel and bronze; a good opening for an up-to date man. Box 115, AM. MACHINIST.

Wanted—A man between 30 and 35 years of age who has had a thorough practical shop experience making fine machinery. None except those thoroughly competent need apply. Treated confidentially if so desired. Address, with references, age, salary, experience, Box 114, AMERICAN MACHINIST.

The advertiser wishes engagement with parties about to begin or already at the manufacture of steel balls; has many years experience as machinist, draftsman and designer; lately with ball making concern, and also valuable ideas of machines to reduce cost and improve quality. Box 103, AMERICAN MACHINIST

Superintendent Wanted—A thoroughly competent man to take charge of machine, boiler and blacksmith shops in works located in a progressive Western town; must be familiar with engine and boiler work, ice mach'y, and general line of contract work. Only those need apply who feel confident they can fill the bill. Box 118, AM. MACH.

Wanted—A thorough, practical mechanic to act as superintendent of a concern employing about 300 hands. Works consist of a machine shop and foundry making transmitting machinery principally. He must be a man of extensive ability and capable of taking entire charge of the mechanical part of the shop and formulating cost sheets, etc. None but an A No. 1 man with the requisite ability need apply. Box 101, AMERICAN MACHINIST.

Wanted—Foreman to take charge of machine and tool room. Must be an experienced bicycle hand, familiar with Cleveland automatic screw machines and press work, and capable of designing and making tools. No application will be considered unless party has held similar position, and whose character and ability can bear the strictest investigation. Good wages to the right man. Factory near New York City. Address Box 112, AMERICAN MACHINIST.

A mechanical engineer from one of the best schools in the United States, who has had more than ten years experience with several of the leading United States firms in hydraulic machinery, steam engines, boilers and general mechanical engineering work, and who is at present superintendent of erecting for a London firm doing a large engineering business, desires to invest $12,000 in a reputable firm in which he could become engineer or manager. Box 108, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st., N.Y.

Wanted—A full lot of second-hand improved machine tools issuing from cycle manufacturer wishing to sell his machinery. Address prices and complete description of every machine to Mr. Pinet, 66 Cours de Vincennes, Paris, France.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

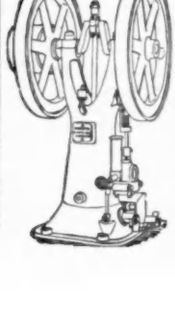
Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

CLOUGH'S COUNTERBORES.

PATENT DUPLEX GEAR CUTTERS and other specialties described in Circular "D." Write for it.
R. M. CLOUGH, 28 Whitney Ave., **New Haven, Conn.**



This beats Wind, Steam or Horse Power.
We offer the
WEBSTER 1 1-2 ACTUAL HORSEPOWER
GAS ENGINE
For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.
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Just Published. Two Reliable Books.

"SHOP KINKS,"
By ROBERT GRIMSHAW. Showing special Ways of Doing Work Better, more Cheaply, or more Rapidly than Usual.
400 Pages, 225 Illustrations, $2.50.

"THE MODERN MACHINIST," By JOHN T. USHER, Machinist.
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☞ *Illustrated circulars of both sent free.*

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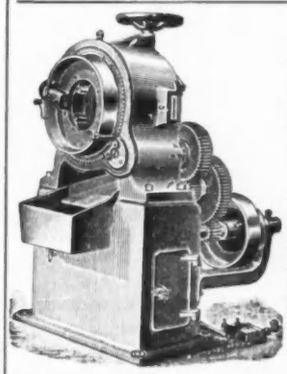
"GAS, GASOLINE AND OIL ENGINES,"
By GARDINER D. HISCOX, M. E.
400 Pages. 200 Illustrations. Price, $2.50.
This book treats comprehensively, and almost entirely of American makes of Gas, Gasoline and Oil Engines, with instructions for the care and management of the same.
Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.
NORMAN W. HENLEY & CO., Publishers,
15 Beekman Street, NEW YORK.



CURTIS & CURTIS,
66 CARDEN ST., BRIDGEPORT, CONN.
Pipe Cutting and Threading Machinery,
FOR HAND OR POWER,
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

(Continued from page 36.)

other classes of work, because it depends upon enterprises which have been definitely under way for a considerable time.

As to further orders for local buildings—placed, however some time ago—the Watertown Steam Engine Company report having sold engines to the Roosevelt Hospital and to the Metropolis Theatre. The high-speed engine department of this company's factory has work enough on hand to keep it running twenty-four hours a day, though their boiler department is rather quiet..

EXPORT TRADE NOTES.

There is not the enthusiasm over exports of engines and boilers that there is over that of machine tools; still there is something doing. Sales for Mexican account are occasionally heard of, one of the latest being that of a Heine boiler of about 100 horse-power.

The Snow Steam Pump Company have been having an excellent and improved foreign trade, notably with Russia, Germany, England, Australia and France. The pumps sold are mostly of moderate size, and differ from those built for home use in having flanged instead of threaded pipe joints.

It need hardly be mentioned that the pumps of that company are handled through a number of foreign houses, so that they are not totally dependent upon the intermediary of catalogs to recommend their goods. We know that certain other pump companies are well represented abroad, so that this branch of industry may not be exposed to the censure which, in a letter from Fuerth published in a late volume of consular reports, is awarded to our manufacturers because

they do not make the same effort to introduce their goods into Germany that the German does to put his goods upon the United States market. The writer alluded to refers to the German method of pile-driving; i. e., to attach some twenty-five hand ropes to a block and fall, and set as many men at hoisting a weight 18 inches or 2 feet, and letting it drop again, until the pile is driven into the ground. Similarly, in the erection of buildings, every stone raised requires the strength of a team of horses and about fifteen men tugging away at the rope; and the machinery made and used in the United States for this purpose does not seem to be on the market there.

The Central Railroad Company of South America has placed an order with the Newton Machine Tool Works, of Philadelphia, for a milling-machine equipment, including the heaviest class of rod-milling machines, heavy plain milling machines, nut-milling machines, vertical rotary planers, etc. The tool company is well satisfied with its business outlook.

A Pekin press dispatch says that an American syndicate will advance 30,000,000 taels for the construction of the Hankow-Pekin Railroad, which is to be 700 miles long and to cross twenty-seven rivers; the entire works to be transferred to the syndicate, but the shares ostensibly to be held in China.

The Department of Trade and Commerce at Ottawa gravely reports the naïve proposition made by a Mr. Thomas Moffat, of South Africa, to establish a line of steamers from Montreal to Cape Town, on the ground that the intense "loyalty" of the South Africans will induce them to transfer their patronage, so far as possible, from the United States to Canada.

Recent exports of machinery from the port of New York as compiled from manifests of outgoing cargoes made public during the week ending October 24th, amounted to $184,282.

IRON AND OTHER METALS.

The pig iron market has shown some recovery from its downward reaction of the last two or three weeks. A leading firm who have an office in this city have sold 5,000 tons of iron to a cast iron pipe foundry and two 1,000 ton lots for car wheels. Bessemer pig is now quoted in Pittsburg about $1.00 per ton higher than when the price was most depressed.

The metal markets this week have shown some strength.

Quotations.

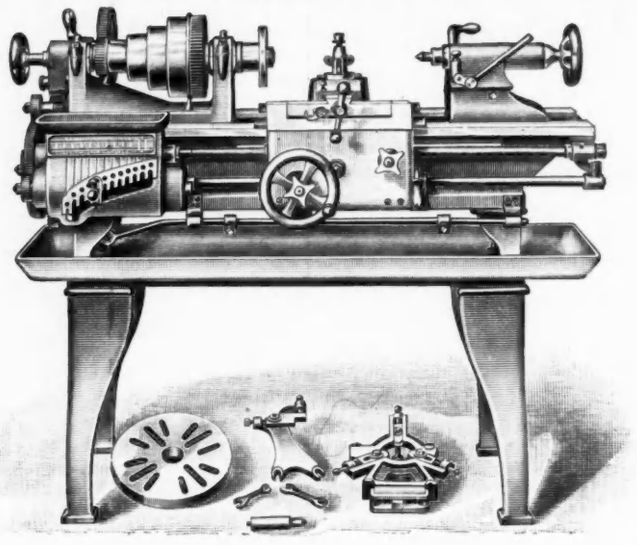
NEW YORK, Monday, October 26th.

Iron—American pig, tidewater delivery:	
No. 1 foundry, Northern	$11 75 @ $13 00
No. 2 foundry, Northern	11 25 @ 12 00
No. 2 plain, Northern	10 50 @ 11 00
Gray Forge	10 50 @ 10 75
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	11 00 @ 11 25
No. 3 foundry, Southern	10 50 @ 10 75
No. 1 soft, Southern	11 00 @ 11 25
No. 2 soft, Southern	10 75 @ 11 00
Foundry forge, or No. 4 Southern	10 25 @ 10 50

Slightly higher quotations on some of the Northern irons might perhaps be justifiable

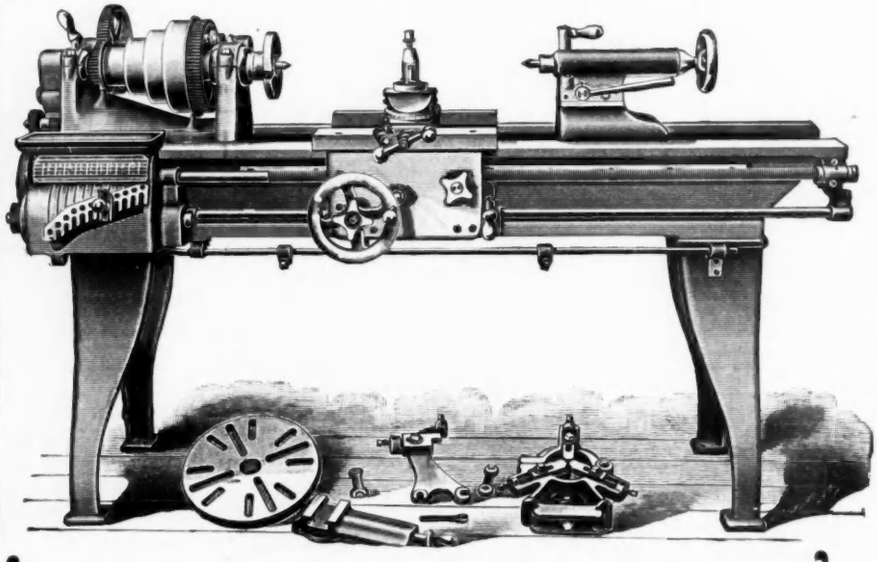
Bar Iron—Base—Mill price, in Carloads, on dock:

(Continued on page 39.)



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

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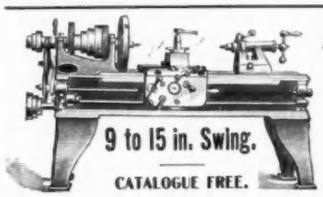

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(*Continued from page 38.*)

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▲ ▲ ▲

Manufactures.

D. P. Holland, of Atlanta, Ga., will build a new wire nail factory.

W. H. Berry, Philadelphia, Pa., will erect a boiler manufacturing plant.

Providence Hosiery Mills, Bristol, Pa., will erect a plant and install machinery.

H. C. Druggens Mill Co., Petersburg, Tenn., will install a line of milling machinery.

The Barnes National Safe Co., Detroit, Mich., will erect a $25,000 manufacturing plant at once.

The La Belle Steel Co., of Wheeling, W. Va., are enlarging their steel and tin plate departments.

American Manufacturing Co., Waynesboro, Pa., will install machinery for manufacturing patent plaster.

M. S. Johnson, York, Pa., will erect a powder factory near Lebanon, Pa., and will place new machinery.

Darlington & Reeder, Bloomfield, Pa., will erect a large rim factory and planing mill, and will place machinery.

Marlet, Mich., will erect a city lighting and power plant. All latest improved electrical machinery will be installed.

The last works at Granby, Que., Canada, owing to increased business, have decided to increase their buildings and plant.

Hopper & Schnell, manufacturing machinists, of Macon, Ga., are enlarging their works, and intend to install new machine tools.

Waukesha Electric Co., Waukesha, Wis., will erect a modern electricity power plant. All latest improved electrical machinery will be installed.

The Manistee Fuel and Gas Company is the name of a new concern organized at Manistee, Mich., capital $100,000, to manufacture and sell gas for fuel.

Currey & Caslitine, Three Rivers, Mich., will erect and equip a modern laundry at a cost of $15,000. The latest laundry machinery will be installed.

The Commercial Printing Co., at Ypsilanti, Mich., will spend $20,000 in thoroughly equipping the plant with latest and improved printing machinery, engine, etc.

A new concern, known as the Alexandra Manufacturing and Foundry Co., has been organized at Alexandra, Ind., to manufacture general machinery and operate a general foundry business. Capital $15,000.

The United States Leather Co., Marinette, Wis., will erect an immense tannery costing $500,000. All the latest and most improved machinery will be installed.

The Detroit, Mich., Furnace and Heater Co., with a capital of $15,000, has been incorporated. The principals are Thos. W. Palmer, B. H. Edwards and W. W. McAlpin.

The River Side Brick Co., De Pere, Wis., will erect a large plant to manufacture a fine grade of pressed brick. Presses, molds, engines, excavators, etc., will be installed.

H. Alfred Streull, of Plainfield, N. J., owner of the Sterling silk mill, that was burned two weeks

ago, has decided to rebuild, and work will be started in a few days.

The Madison Street Railway Co., Madison, Wis., will expend $16,000 in replacing electrical machinery in their power houses. Only latest improved machinery will be installed.

The Acetylene Gas Co., Minneapolis, Minn., will erect a modern gas manufacturing plant. $100,000 will be expended in equipping the plant with the latest improved machinery.

Illinois Insulated Wire Co., Sycamore, Ill., will erect a $115,000 plant to manufacture and insulate wire. All latest improved braiding, twisting, winding machinery, engine, etc., will be installed.

Gladstone, Mich., has disposed of $50,000 bond issue, and a modern city electric lighting plant will be erected and equipped at once. Engines, pumps and latest electrical machinery will be installed.

The Standard Bicycle Manufacturing Co., Chicago, Ill., will expend $50,000 in thoroughly equipping a modern plant with all improved machinery, lathes, drills (multiple), planers, engines, buffers, etc.

The Dodson Manufacturing Co , Chicago, Ill., will expend $100 000 in thoroughly equipping with modern machinery a modern bicycle manufacturing plant. Lathes, multiple drills, engine, etc., will be installed.

The Scribney Organ Co., recently formed at London, Ont., Canada, have secured from Mr. Birtwhistle the old baby carriage and rattan factory on King street, and will at once proceed to occupy the whole building for the manufacture of their patent organ.

A company, known as the Baron Manufacturing Co., for the manufacture of metals, alloys, etc., has been formed in New York City, with a capital of $50,000. The directors are Aime Baron, Paris, France; Robert A. Cheschrough, William R. Garrison, Paul Fuller and Frederic R. Coudert, of New York City.

The Berlin Iron Bridge Co., of E. Berlin, Conn., are to erect a new power house and car barn for the Union Traction Co., of Rutherford, N. J. These buildings will be built of brick with steel frame work, and the plant to be installed will be of the most improved type. The engine room is 20 x 65 feet, and the boiler room 40 x 65 feet.

The following new mining companies have been organized in British Columbia: Alberta Gold Mining Co., Spokane, capital $1,000,000; Chicago Gold Mining Co., capital $500,000, Spokane; Electrical Reduction and Refining Co., capital $25,000, head office, Rossland, B. C.; Exchequer Gold Mining Co., $1,000,000, head office Nelson, B. C.; Hercules Gold Mining Co., $2,000,000, Rossland, B. C.; Northern Light Gold Mining Co., $250,000, Victoria, B. C.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

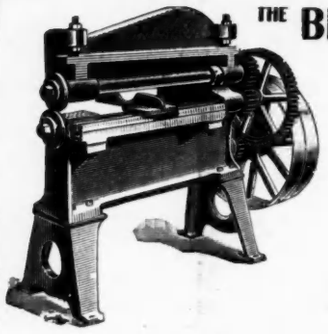
The Almy Water Tube Boiler Co., Providence, R. I., send us a catalog devoted to the illustration and description of boilers made by them, and which are made in several different styles. The catalog is 5½ x 8½ inches.

We have received from J. E. Reinecker, Chemnitz-Gablenz, Germany, a catalog printed in German, illustrating and describing machine tools made by him, which include milling machines, lathes, etc. It is 5 x 7 inches.

Diamond Machine Co., Providence, R. I., send us a catalog devoted to the illustration and description of machinery used in the manufacture of bicycles, such as grinding and polishing machinery, presses, drills, etc. The catalog is 6 x 9¼ inches.

We have received from the Murray Iron Works Co., Burlington, Ia., a copy of their catalog No. 27, which contains illustrations and descriptions of boilers, pumps, engines, feed water heaters, etc., made by them. The catalog is nicely gotten up, well illustrated and is standard size, 6 x 9 inches.

Norton Emery Wheel Co., Worcester, Mass., send us a catalog which illustrates and describes the Bath Indicator, an instrument for testing the truth and alignment of machine parts, and which is made by this company. Illustrations are given of the application of the indicator. The catalog is 4½ x 6 inches.



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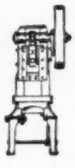

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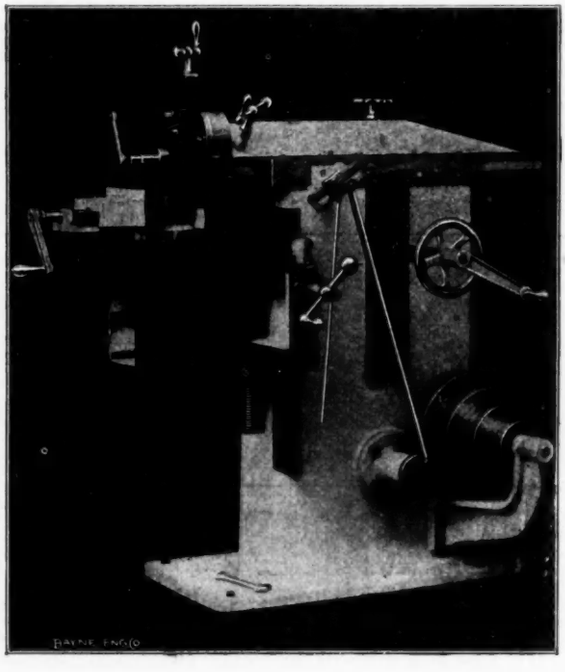

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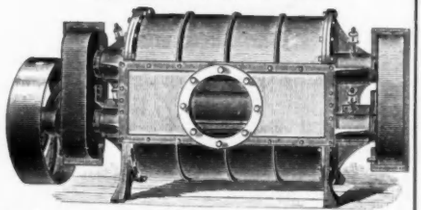

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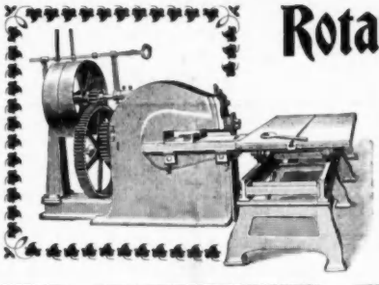

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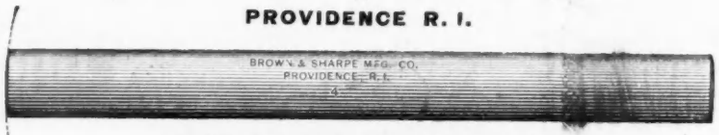

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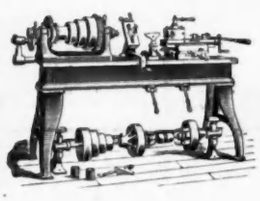

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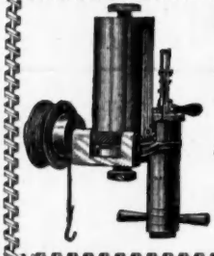

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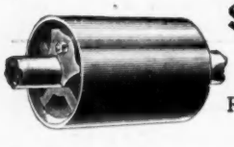

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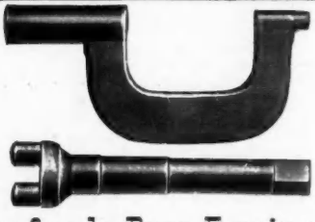

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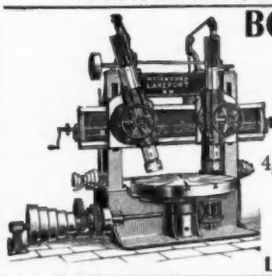

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